Popular Science

FOUNDED MONTHLY 1872

Would you-

risk your life for 50 feet of film?

See page 20

$1,000 IN CASH PRIZES EVERY MONTH

APRIL

25 CENTS

Turn the magic key of color

EVERY FINISH CORRECT,
as specified on the Household Painting Guide

MODERN color is the key that will unlock the latent possibilities for beauty in your home.

We recommend that you consult the new COLOR SUGGESTIONS of the Sherwin-Williams decorative experts, to be found at the up-to-date paint store known as *Paint Headquarters*. Recognize the store by the sign and by the Household Painting Guide. The Guide stops mistakes in painting by showing the best possible finishing materials for each job.

HOUSEHOLD PAINTING GUIDE
STOPS MISTAKES IN PAINTING

SURFACE	TO PAINT USE PRODUCT NAMED BELOW	TO VARNISH USE PRODUCT NAMED BELOW	TO STAIN USE PRODUCT NAMED BELOW	TO ENAMEL USE PRODUCT NAMED BELOW
AUTOMOBILES	S-W Auto Enamel	S-W Auto Enamel Clear		S-W Auto Enamel
AUTOMOBILE TOPS AND SEATS	S-W Auto Top and S-W Auto Seat Dressing			
BRICK	SWP House Paint S-W Concrete Wall Finish			Old Dutch Enamel
CEILINGS, Interior	Flat-Tone	Scar-Not Varnish	S-W Handcraft Stain Floorlac	Enameloid
Exterior	SWP House Paint	Rexpar Varnish	S-W Oil Stain	Old Dutch Enamel
CONCRETE	S-W Concrete Wall Finish			
DOORS, Interior	SWP House Paint	Scar-Not Varnish Velvet Finish No. 1044	Floorlac S-W Handcraft Stain	Enameloid
Exterior	SWP House Paint	Rexpar Varnish	S-W Oil Stain	Old Dutch Enamel
FENCES	SWP House Paint Metalastic S-W Roof and Bridge Paint		S-W Preservative Shingle Stain	
FLOORS, Interior (wood)	S-W Inside Floor Paint	Mar-Not Varnish	Floorlac	S-W Inside Floor Paint
Concrete	S-W Concrete Floor Finish			S-W Concrete Floor Finish
Porch	S-W Porch and Deck Paint			
FURNITURE, Indoors	Enameloid	Scar-Not Varnish	Floorlac	Old Dutch Enamel Enameloid
Porch	Enameloid	Rexpar Varnish	S-W Oil Stain	
HOUSE or GARAGE Exterior	SWP House Paint	Rexpar Varnish	S-W Preservative Shingle Stain	Old Dutch Enamel
LINOLEUM	S-W Inside Floor Paint	Mar-Not Varnish		S-W Inside Floor Paint
RADIATORS	Flat-Tone S-W Aluminum or Gold Paint			Enameloid
ROOFS, Shingle Metal Composition	S-W Roof and Bridge Paint Metalastic Ebonol		S-W Preservative Shingle Stain	
SCREENS	S-W Screen Enamel			S-W Screen Enamel
TOYS	S-W Family Paint	Rexpar Varnish	Floorlac	Enameloid
WALLS, Interior (Plaster or Wallboard)	Flat-Tone SWP House Paint			Old Dutch Enamel Enameloid
WICKER	Enameloid	Rexpar Varnish	Floorlac	Old Dutch Enamel
WOODWORK Interior	SWP House Paint Flat-Tone	Scar-Not Varnish Velvet Finish No. 1044	S-W Handcraft Stain S-W Oil Stain Floorlac	Old Dutch Enamel Enameloid

For removing paint and varnish use Taxite. For cleaning painted and varnished surfaces use Flaxoap.

FREE: If you wish some special individual recommendations for a room or a whole house write to the Sherwin-Williams Department of Home Decoration. Also send us the coupon printed below and receive, free, a valuable brochure in colors on home decoration. Send the coupon *now*.

The Sherwin-Williams Co., *largest paint and varnish makers in the world*, Dept. D, 659 Canal Road, Cleveland, Ohio.

SHERWIN-WILLIAMS
COVER THE EARTH
PAINTS AND VARNISHES

Free: Beautiful Color Ideas
Send this Coupon

Give us your name and address and receive, entirely free, a very special art brochure on homes of beautiful homes. Lovely interiors and exteriors in colors. Samples of many popular shades—each a correct Sherwin-Williams product, as specified on the Household Painting Guide. Send the coupon today, to The Sherwin-Williams Co., Dept. D, 659 Canal Road, Cleveland, Ohio.

NAME ____________________

ADDRESS ____________________

Taylor Instruments make WRIGLEY'S GUM even better

By E. F. Marsh, Master Mechanic
The Wm. Wrigley, Jr., Company, Chicago

"To provide the world with an even better grade of Wrigley's gum, Taylor Instruments do their full share. We have had Taylor Recording Thermometers on our hot water, hot oil and steam lines for eight years, as well as one Taylor Regulator on our corn syrup tanks and 5 Taylor Hygrometers for the air conditioning of our wrapping and storing rooms.

"In our work, we have very exacting standards and any fall-down on the part of our indicating or regulating instruments would result in considerable losses—but there is no need for worry with *Tycos* instruments.

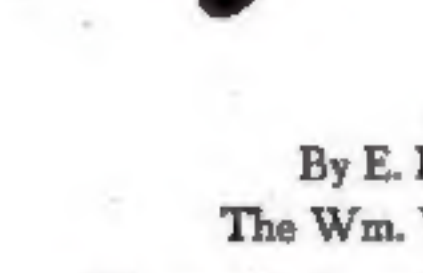
"Previous to the use of *Tycos* Temperature Regulators on our corn syrup tanks we lost considerable time through keeping the work in process longer than was necessary. The saving in labor costs alone due to the elimination of this lost time more than paid the entire cost of the two instruments the first two years. Besides this, there were savings due to increased production, and elimination of failures to keep schedules as well as the advantages of a greater uniformity of product under given conditions.

"The charts provided by the *Tycos* equipment have also proved valuable in our constant effort to improve processes and the quality of our product. By means of these charts we have a permanent record of the condition prevailing during process. Knowing this, we have the necessary facts to make improvements."

TO MANUFACTURERS

In the *Tycos* line of 8000 different kinds of Heat Indicating, Recording and Controlling Instruments, there are instruments that will help you get absolute uniformity in your productions. It will pay you to learn how other manufacturers are using the Sixth Sense of Industry to get uniform results. Informative literature on any type of instrument will be sent you on request. Or our engineers will consult with you on the application of *Tycos* to your particular manufacturing problem.

Taylor Instrument Companies
Main Office and Factory
ROCHESTER, N. Y. - - U. S. A.
Canadian Plant: *Tycos* BUILDING, TORONTO
SHORT & MASON, Ltd., Manufacturing Distributors in Great Britain



Tycos FOR THE HOME

***Tycos* Office Thermometers**
An aid to promoting human efficiency.

***Tycos* Bath Thermometers**
To enable you to get the most good from your baths.

***Tycos* Wall Thermometers**
To help you maintain a temperature in your house conducive to good health.

***Taylor* Quality Companions**
To show you the right way in new familiar country.

***Tycos* Hygrometer**
To enable you to keep the humidity of the atmosphere in your home correct at all times.

***Taylor* Home Set**
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

***Tycos* Fever Thermometers**
A necessity in every home.

***Tycos* Stormoguide**
Forecasts the weather twenty-four hours ahead with dependable accuracy.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above

Tycos FOR THE MEDICAL PROFESSION

Tycos Sphygmomanometer, Pocket and Office types. *Tycos* Urinalysis Glassware.
Tycos Fever Thermometers. Bulletins on request.

THE SIXTH SENSE OF INDUSTRY

Tycos Temperature Instruments

INDICATING • RECORDING • CONTROLLING

Popular Science Monthly

The Magazine of Invention and Discovery

APRIL, 1926; Vol. 108, No. 4
25 cents a Copy; $2.50 a Year

Published in New York City at 250 Fourth Avenue

Don't Miss These Features

IF YOU have enjoyed and profited by the series of mental tests which have been appearing in POPULAR SCIENCE MONTHLY, you won't want to miss the fascinating story of America's greatest puzzle expert, beginning in next month's issue. Throughout his remarkable career, he has invented more brain-twisters than any other man. From the thousands of puzzles which he has devised in half a century, he has selected the ones he considers the very best. These you will have a chance to tackle. So begin now to sharpen your pencil and your wits. Watch for the May issue, appearing April 10.

* * *

HOW would you like to own a beautiful ship model? Next month one of the world's leading experts on the subject will show you just how you can build one yourself with ease—and the cost will be less than $5. It is a perfect little replica of a famous Spanish galleon that will be fully as picturesque and realistic as the most expensive model you could buy. Here's an unusual chance to make a thing of lasting value. And you need not be an expert to do it.

Captain E. Armitage McCann, noted expert on ship models, working on the hull of a beautiful little replica of a Spanish galleon which he will tell you how to build in next month's issue

HUNDREDS of readers who entered the first of our new Picture Contests last month have written telling us how glad they are that John and Mary Newlywed are continuing their adventures in homemaking. If you have not yet tried your hand at solving the problems of John and Mary, you're missing a lot of profitable enjoyment. Each month we are offering $1,000 in cash prizes. You have as good a chance as anyone to win. Turn to page 14.

* * *

THE announcement of Grand Prize winners in our remarkable $10,000 "What's Wrong" contest appears on page 55. Whether you entered this contest or not, you'll be interested in reading how the leading contestants won the big cash awards.

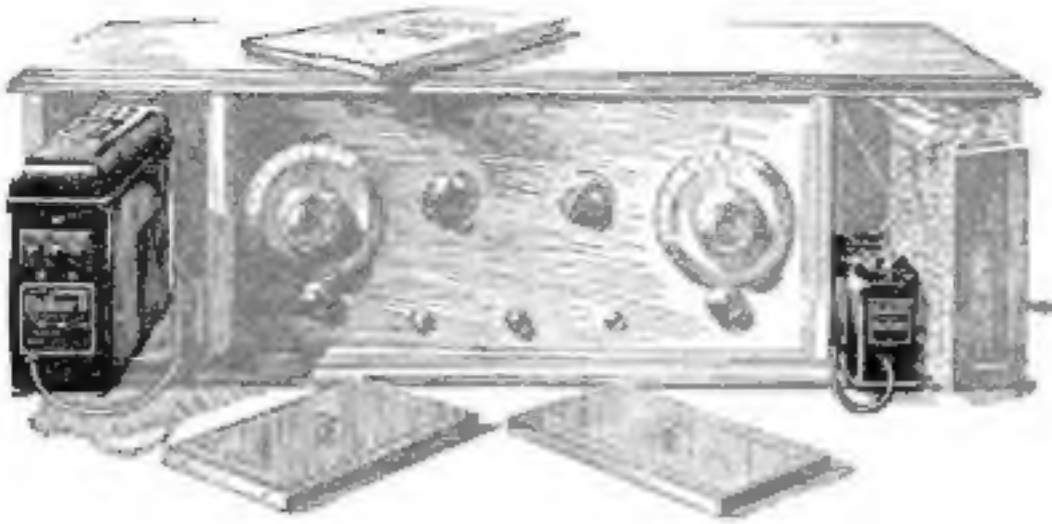
* * *

IF YOU like animals, and if you are fond of sports, you will find Arthur Grahame's article on whippet racing, on page 26 of this issue, one of the most enjoyable you ever have read. As you look at the remarkable photograph at the top of the page, you will marvel at the little four-legged racing machine that can "win in a walk" from human sprinters.

In This Issue—200 Articles and Pictures, including

POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, $2.50; foreign countries, $3. Entered as second-class matter Dec. 29, 1914, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A.



Convert your receiver into A LIGHT SOCKET SET *with* Balkite Radio Power Units

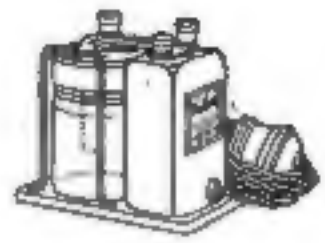
Balkite Radio Power Units enable you to make a light socket set of your present receiver. The Balkite Trickle Charger converts your "A" battery into an automatic "A" power unit that furnishes full "A" current from the light socket at all times. Balkite "B" replaces "B" batteries entirely and furnishes "B" current from the light socket. As an added convenience you may purchase from your dealer an automatic switch that cuts out the charger and turns on Balkite "B" during operation.

This popular light socket installation is the last word in radio convenience. It is extremely simple to install, economical both in initial cost and in operation, compact and composed entirely of units that have demonstrated their success over a period of time.

Noiseless—No bulbs—Permanent

All Balkite Radio Power Units are permanent pieces of equipment, entirely noiseless, have no bulbs, no moving parts, nothing to break or get out of order. Their current consumption is ridiculously low. All operate from 110-120 volt AC current, with models for 50, 60 and other cycles. *All are tested and listed as standard by the Underwriters' Laboratories.* . . . . . At your dealer's.

[*The Balkite Railway Signal Rectifier is now standard on over 50 leading American and Canadian Railroads*]



Balkite
Trickle Charger

Converts any 6-volt "A" battery of 30 ampere hours capacity or more into an automatic "A" power unit that furnishes "A" current from the light socket. With 4-volt and smaller 6-volt batteries may be used either as an intermittent or trickle charger. $10. West of Rockies, $10.50. In Canada, $15.

Balkite
Battery Charger

The popular rapid charger for 6-volt "A" batteries. Noiseless. Can be used while the set is in operation. Special model for 25-40 cycles, $19.50. West of Rockies, $20. In Canada, $27.50.

Balkite "B"

Eliminates "B" batteries and supplies plate current from the light socket. For sets of 5 tubes and less. $35. In Canada, $49.50.

Balkite "B" II

Supplies plate current from the light socket. Will serve any standard set. Especially adapted to sets of 6 tubes or more. $55. In Canada, $75.

FANSTEEL

Balkite *Radio Power Units*

MANUFACTURED BY FANSTEEL PRODUCTS COMPANY, NORTH CHICAGO, ILL.

SOLE LICENSEES IN THE UNITED KINGDOM MODEL RADIO ACCESSORIES LTD., 9-13 HYTHE RD., WILLESDEN, LONDON, N. W. 10

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Short Cuts to Success

True Stories of Success As Told by Readers of Money Making Opportunities Section

As A service to the readers of this magazine, the advertisements of courses of training, residence schools, technical books, sales agencies, patent attorneys, and advertisements of a similar nature are now grouped together in the Money Making Opportunities Section.

The short cut to success today is *specialized* knowledge. To know more about your job than does the other man is the first step toward success. Men who succeed are the men who have specialized—they have studied and learned more about the job they are doing than their fellow workers.

To focus the attention of POPULAR SCIENCE MONTHLY's readers on the new Money Making Opportunities Section, we are offering $100 every month in cash prizes for the best "true stories" of success. The details of this offer will be found on page 114.

Getting "Real Money" for Ideas

The first prize of $50 in last month's contest goes to H. M. Dwinell of Hayward, Calif., for his intensely human letter telling how he and his "young gang" are studying the course of the Bureau of Inventive Science. Here is Mr. Dwinell's letter:—

Contest Editor:

The advertisement, "How to Invent," by the Bureau of Inventive Science, is the most interesting in your Money Making Opportunities.

Several years ago I built a little workshop in my backyard. I bought some tools and with the help of blueprints secured from your publication, I and my three sons built many useful articles for home use. When we started on a radio outfit (we were among the first), every boy in the neighborhood became interested.

Now, I am going a step farther. I and my young gang shall study "How to Invent." Who knows what budding genius, as yet undiscovered, may be in that same gang?

I anticipate many happy hours in my spare time, companionship of the growing boys, and later on money and perhaps an invention of great blessing to mankind. Sincerely yours,

H. M. DWINELL.

$100 in Cash Prizes

For the best letter in answer to the questions:

What advertisement in the MONEY-MAKING OPPORTUNITIES SECTION interests you most—and why?

we will pay $100 in cash prizes. For full details—

See Page 114

The Money Making Opportunities Section is the great meeting place for men who want to succeed and for the schools and publishers that can help them.

The second prize of $25 is paid to Frederick W. Lentz, of Weatherly, Pa. Here is his letter telling how the LaSalle Extension University helped his brother and himself:—

Dear Sir:

Most of us consider that "Seeing is believing." That is why I think the most interesting advertisement in the February POPULAR SCIENCE MONTHLY is that of the La Salle Extension University which appears on page 135 under "Money Making Opportunities."

Several years ago, my brother-in-law took a course in the LaSalle Extension University. At the time he was a clerk for an oil company. Today, through his knowledge gained from this course, he is one of the managers of the company.

From pointers which I received from him, I was able to advance myself from an office clerk to a position as a state sales manager for a large jewelry manufacturing company. I intend to take a course with the La Salle Extension University, too, because I see that it is a real investment and "Money Making Opportunity." All one invests is a little time and brains.

FREDERICK W. LENTZ.

From prairie farmer to a successful traveling salesman is the story of F. F. Cottrill. His letter regarding the National Salesmen Training Association is a perfect illustration of the short cuts to success that are offered the readers of POPULAR SCIENCE MONTHLY. The third prize of $10 goes to F. F. Cottrill, of Fort William, Ontario, for this letter:—

Dear Sir:

Some four years ago I was a prairie farmer, working 15 hours a day for a mere living, with no future, really gambling with nature for an existence, with all the odds on her side, when I happened to read one of Mr. Greenslade's ads on salesmanship.

It appealed so greatly to me that I had to send for it. This was during the winter months, and to make a long story short, his course gripped my imagination so vividly that before spring, I had rented the farm and was prepared to do or die as a salesman.

(Continued on page 114)

91 Short Cuts to Success

SEE PAGES 114-142

130,000 times better

One of the great steps forward in the development of the Radiotron was the evolution of the X-L filament.

When you tune in to clear reception, do you know that a stream of electrons leaping from a glowing filament is the current which, translated into sound, you hear as a symphony, a jazz orchestra, a clever story?

The more electrons thrown off at a given temperature, the longer the tube lasts, and the longer the batteries last. The X-L filament in Radiotrons UV-199 and UV-201-A throws off, at operating temperature, 130,000 times as many electrons as an ordinary tungsten filament. In one sense, therefore, the X-L filament is 130,000 times better!

And this filament means stability, too—and silent operation. And it keeps its efficiency practically to the end of its life.

Watch for the RCA mark on every tube you buy, and know that you have the latest, most perfected tube, as well as the most accurately made.

Radiotron UV-201-A

is the standard tube for storage battery sets. UX-201-A is exactly like it, but has a new base.

Radiotron UV-199

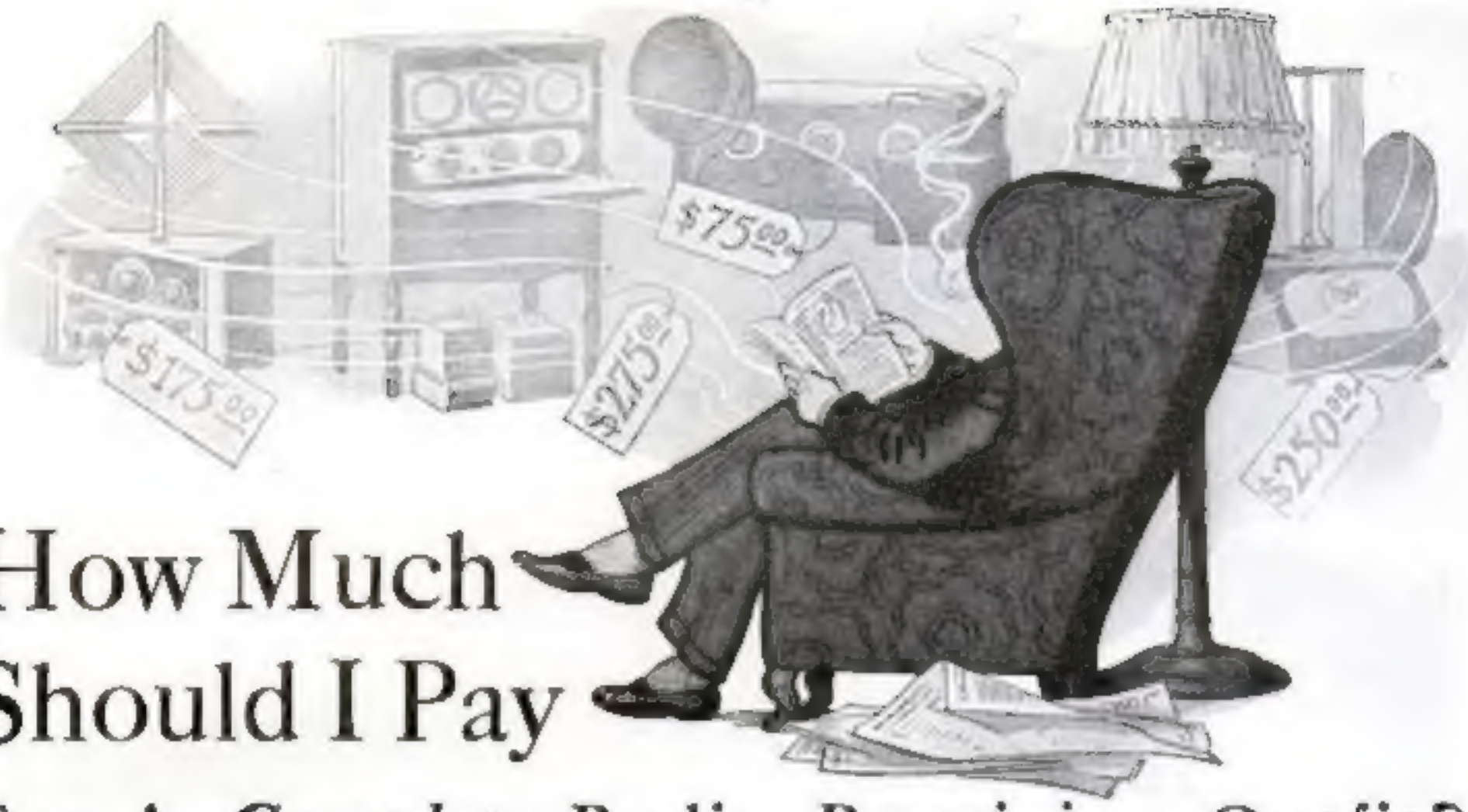
is the standard tube for dry battery sets. UX-199 is exactly like it, but has a new base.

RADIO CORPORATION OF AMERICA
New York Chicago San Francisco

RCA Radiotron

MADE BY THE MAKERS OF RADIOLAS

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



How Much Should I Pay

For A *Complete* Radio Receiving Outfit?

By COLLINS P. BLISS, M.A.
Director, Popular Science Institute of Standards

AGAIN AND AGAIN, readers ask us the question, "How much must I pay for a really good radio outfit, complete?"

We wish it were possible to give a definite answer in figures. But "really good" is such a comparative term that, without knowing the prospective purchaser's location, price limit and requirements, it is impossible to give more than a general answer.

There are Fords in radio and there are Rolls-Royces in radio—as well as Studebakers in between. Nobody can deny the efficiency of the Ford; it is an excellent car for the money. Yet $910 is not the established price of a really good car. And there are cars that cost more than this price that are not efficient.

What the Popular Science Institute of Standards has done is to test the various receiving-sets and accessories on the market in order to determine which ones are capable of giving satisfactory service and are good value. The list of radio products that have been approved by the Popular Science Institute includes the equivalents of Fords, Studebakers and Rolls-Royces; it *does not* include the radio equivalents of cars that keep auto repair shops busy.

IN BUYING a complete radio outfit, the prospective purchaser should not overlook the financial meaning of the word "complete"; otherwise, he is likely to overstep his allotment. Fifty dollars is not too much to set aside for accessories. This figure is based on list prices for loudspeaker, tubes and batteries to go with a five-tube set. The price of the set itself does not affect the cost of accessories to any great extent, though the man who is making a substantial investment will probably want to include a battery charger or eliminator in his outfit.

Another question that is put to the Popular Science Institute often, in one form or another, is whether the difference in price between sets of the same size is warranted. It is, and it is not. Whether a product represents good value or not is one of the chief points that the Popular Science Institute of Standards takes into consideration in testing radio receiving-sets, as well as all other radio and tool products. No matter how good a set is, if it does not come up to the standards required for its price class, it is not approved by the Popular Science Institute.

In buying a high-priced set, there is one important factor that the purchaser should take into consideration. That is, what proportion of his money is to go toward furniture, and what proportion toward radio. If he is going to put $200 into a radio receiving-set, and wants a more or less elaborate piece of furniture, he cannot expect his set to be superior electrically to a less expensive set in a plain cabinet. Therefore, it is advisable for the radio purchaser who is after electrical efficiency alone, to choose the set in the plainer cabinet.

ASIDE from the question of cabinet, and considering the chassis of sets alone, there are expensive sets on the market which are well worth the difference in price between them and less costly radio receivers. It is true, though, that the difference in operation between a $150 radio receiving-set and a set costing $250 is not nearly as marked as the difference between a $50 receiving-set and the one costing $150.

This is due to the fact that once a set reaches a certain degree of efficiency, it is an expensive and difficult task for the manufacturer to advance it beyond the "good" stage into the "excellent." This accounts for the fact, noticed by many of our readers, that very expensive receivers do not give proportionately greater distance reception than the cheaper sets. If they get 1,000 miles on a $100 set, they expect a set costing $200 to bring in stations twice as distant, and are almost invariably disappointed.

It must be remembered that sensitivity for distance reception is only one of the many features that go to make up a good radio receiving-set. A really excellent set has a high degree of selectivity coupled with fine tone quality, as well as sensitivity. It is this *combination* of qualities that distinguishes the expensive receiver from the cheap one.

What applies to sets, applies to other radio products on the market today. There is some equipment that is not good value at any price. There is other apparatus that represents good value. A list of this worth-while equipment that has passed laboratory and practical tests is available to all readers of this magazine. Send 20 cents for the List of Approved Products to the Popular Science Institute, 250 Fourth avenue, New York, N. Y.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Health and happiness through radio

Each morning, young and old everywhere are adding to their store of health by doing the setting-up exercises broadcasted from many stations. Each evening radio adds to their pleasure and happiness through the dance programs.

In developing receiving sets that make the benefits of radio broadcast reception practical for everyone, radio engineers have found Bakelite to be superior for a great variety of radio parts—particularly those that are vital to clear reception and true tonal quality.

Bakelite is the preferred material for panels, dials, knobs, condensers, tube sockets and tube bases, plugs, rheostats and for other radio devices, including speakers. In fact, 95% of radio set and parts manufacturers use Bakelite as they have found that its permanently high insulation value, its strength, its lasting color and finish, its immunity to injury through exposure to heat or moisture, make it superior for radio use.

It is always best to make sure that the radio set or parts that you buy are Bakelite insulated.

Write for Booklet 25

BAKELITE CORPORATION
247 Park Avenue, New York, N. Y.
Chicago Office: 636 West 22nd St.

BAKELITE CORPORATION OF CANADA Ltd.
163 Dufferin Street, Toronto, Ontario, Canada

BAKELITE

REGISTERED U. S. PAT. OFF.

THE MATERIAL OF A THOUSAND USES

"The registered Trade Mark and Symbol shown above may be used only on products made from materials manufactured by Bakelite Corporation. Under the symbol "B" is the numerical sign for infinity, an unlimited quantity. It symbolizes the infinite number of present and future uses of Bakelite Corporation's products."

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

HERO WORSHIP

THE SNOW swirled outside. Within, we huddled about the grate fire and discussed the coal shortage and other things. "Red" Grange was mentioned. Then came hero worship. The engineer—one of the most distinguished in America—thought it all wrong that men should be so revered.

But his views must be accepted with reservations. Some form of hero worship is good for all of us. It is one of the most valuable incentives to human endeavor. Without it, we should not have much of our boasted enlightenment and progress.

Think of the story of sixteen-year-old Bengt Stroemgren that has just come from Denmark. This lad has constructed an electrical apparatus which automatically registers the movements of the stars. By pressing a button he saves astronomers long hours of patient watching through telescopes.

An amazed group of scientists heard young Stroemgren modestly attribute his success to hero worship. His hero was his father, the director of the Copenhagen Astronomical Observatory. Striving only to emulate his distinguished parent, the boy seemed surprised to find that he had made himself of practical use to his fellowmen.

His Hero Was His Father

This sixteen-year-old Danish lad, Bengt Stroemgren, has constructed a photo-electric "eye" which, connected to a chronograph, records and measures the speed of moving stars.

My mind runs back to a little Missouri schoolroom where a gray-haired, 53-inch woman taught English and propounded philosophy. One day she said:

"Read history. Read biography. These are the records of human achievement. Find your example and follow it. Couple the inspiration you get from it with imagination and enthusiasm, and I'll be proud of you yet."

Unfortunately, it took most of us years to appreciate her wisdom and profit by it.

The principal thing, of course, is to select the right hero. And, having been selected, he should be measured as that old New England carpenter measured his lumber. Commenting on the absence of waste on his jobs this fine craftsman explained, "I always measure twice and cut once."

Turn to the story of Luther Burbank and his plants on page 11 of this issue. There is inspiration, enough for all of us. Then on page 17 read the story of Charles Goodyear, who pawned his umbrella to give us rubber. See if you don't find the old, plain rules for human achievement there, too. They are to be found in the record of everyone who is fit for hero worship.—S. N. B.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
April, 1926

What Burbank Plans *to Do* in the Next Five Years

The Plant Wizard's Amazing Vision of a Better Human Race Produced by Methods Learned from Growing Things

By H. H. Dunn

Mr Dunn's article is particularly timely in view of the controversy aroused by two recent declarations by Luther Burbank, one claiming that he possesses power to heal diseases by "the laying on of hands," the other expressing his views on immortality and the nature of God. Physicians and clergymen in America have manifested widespread interest in Mr. Burbank's views.—The Editor.

OUTSIDE, the California sunshine poured down on gardens riotous with many-colored beauty. Inside, behind a roll-top desk in a bare office, sat one of the really great men of our time.

A carelessly-dressed man was this Luther Burbank whose fame has girdled the globe, a simple man who sat unembarrassed in his shirt sleeves, whose collar button, holding an old fashioned collar, glinted above the loosely adjusted knot of an old-fashioned tie. Silver white hair framed pleasantly a keen Yankee face, and blue eyes remarkably clear gleamed amused and tolerant surprise at what seemed to him a most foolish question.

"What is yet to be done?" He repeated my question in a tone of gentle scorn. "Everything! I have made only a beginning in the development of plants to the service of man. In the next five years I hope to produce plants with grains and fruits larger than any we have at present, with more varied flavors and colors, with better storing and shipping qualities, with more nutriment and less waste, and with every poisonous or injurious element eliminated.

"There is hardly a day in which I do not learn something new from the plants in my garden, or from the weeds alongside the road. Experience is the best teacher for the worker with plants. In the years to come I hope to be able to do more useful work than I have done, even in the fruitful years just passed."

Luther Burbank stood on the threshold of his seventy-eighth year that morning. I talked with him in his garden surrounded home in Santa Rosa. Behind him lay more than fifty years of continuous effort. But in the active mind of Burbank, the wizard of growing things, is supreme confidence that he will fill his unique place in the world for many years. Calm, temperate, industrious, he works ten hours a day, six days a week. A patient man! he has grown and destroyed nine million specimens of one variety of plant to obtain a single perfect one.

It is since he passed his seventieth milestone that Luther Burbank has brought his most important plant developments to completion. In these last few years he has produced his composite thick walnut tree which in ten years attains the size of a fifty-year-old wild black walnut and has a wood as fine-grained and valuable as the wild tree, his chestnut tree that begins to produce at six months and is in full bearing in two years, his late-bearing cherry tree with clusters of cherries nearly an inch in diameter, a mulberry tree with leaves twice as large and thick as the ordinary mulberry.

He has brought out a new wheat having heads inches longer than any other. This wheat suitable for all climates, has several to ten more grains to the head, ripens earlier, and resists disease better than other kinds.

He has perfected a beardless, hull-less white barley almost indistinguishable from wheat, with six to eight grains added to each head, and a new rye that grows twice as high as any other and has five to seven more grains to the head.

The Burbank free-stone prune, six inches in circumference, has added millions to the incomes of California fruit growers. He has raised a sunflower with a head eighteen inches in diameter, which grows with its

The Plant Magician in His Workshop

Burbank has more than 2,500 plants under observation in hothouses and on his big farm at Santa Rosa, Calif. The young shoots he is examining here represent years of experiment with thousands of plants

blossoms turned toward the earth, so that the birds cannot harvest the seeds; and a new asparagus with stalks nearly three inches in diameter and as tender at the base as at the tip. Most remarkable of all the Burbank wonders is a spineless cactus, a wonderful cattle food.

In the last two years Burbank has presented to the world a new type of corn with more and larger kernels and shorter stalks than any other species. More than 15,000 experiments were necessary to develop this, and one of his plans for the future is to add more and larger kernels to each ear of this corn.

"WHAT we need most today," Mr Burbank said to me, "is not more varieties of food-producing plants, but greater production from those we have, so that the same number of acres with the labor of fewer men shall produce many times as much food. This will release from the soil men needed for the manufacturing industries, and for other vital work, especially transportation.

"In the next few years I hope to produce fruits that will have the power to resist heat, cold, dampness, and the attacks of fungi and insect pests. I hope also to produce fruit without seeds, stones, spines, or thorns.

"The world needs, and we shall develop, better fiber plants; better coffee and tea plants, more productive spice shrubs, trees that will produce purer rubber in larger quantities and can be tapped as are maple trees. Now, in the tropical rubber forests, the gathering of the rubber means the destruction of the trees.

"We need, too, nuts which contain more oil, new and better flowering plants that will produce starches in profitable quantities, and plants that will yield better perfumes than the synthetic perfumes now manufactured. We need trees exclusively for wood pulp, and other trees that will grow more rapidly than wild trees and produce larger quantities of timber.

"EVERY one of these developments, and thousands more, are within our reach. Man is just beginning to realize that he may some time control certain forces of nature and guide them to produce desired results with a rapidity and sureness hitherto undreamed of."

Luther Burbank's first important contribution to more productive agriculture was the Burbank potato. For this discovery he received $150, and with this modest capital and a supply of his famous tubers, he left his native state of Massachusetts for California. If he had been able to patent this improved potato and had received a royalty of one cent on each bushel that has been grown and sold, he would today be the world's richest man. But in the mild climate of California he found things that were more valuable than vast wealth: the health he was seeking, and the opportunity to continue his life-work of improving the vegetable kingdom.

He studied plant life, and he also studied mankind. And soon he found a close connection between the plant world and the animal world. In his autobiography he says:

"Each atom lives; there is no gulf between the quick and the dead, and the elements of the human brain are found

"Telegraph Plant"

This is one of the latest Burbank creations,—an ornamental growth with huge leaves and flowers, which has been developed from a small, insignificant plant

alike in the pebbles underfoot and the blazing suns of space."

It is most difficult to induce Burbank to talk about his plans for future plant developments. His way is to announce his wonders by presenting to the world the growing, producing, permanent result of his study and experiment. But on the improvement of the human race I found him willing to talk at length.

He believes that the most important lesson he has learned in more than a half century of study of nature is that the laws applicable to the production of improved plant life may be applied with equal success to the improvement of human beings.

"One law governs all; it governs the plants, and it governs us," he said to me earnestly. "Nature does not plan, nature is not *trying* to produce better plants or better men. Nature is neither good nor bad, kind nor unkind, cruel nor merciful. Nature is unconcerned.

"In human breeding, as in plant breeding, there is no satisfactory substitute for intelligent selection and crossing. Here in America nature is forming a mighty combination of various races. If the right principles are followed, we may hope for a race far better and stronger than Americans of today; a magnificent race, far superior to any that the world has seen. But crossing, even when guided by intelligence, produces a myriad of inferior types while producing a few good types. Often, I have produced a million plant specimens to find one or two superlatively good and then destroyed all the inferior specimens.

"INFERIOR human beings, of course, cannot be treated as if they were inferior plants. But if civilization is to endure, some way must be found to produce more of the fit, and fewer of the unfit.

As matters stand, we are making little use of our opportunities for racial improvement. We are not combining the beneficial hereditaries of good types. We are little more than a field of wild weeds, in which, here and there, arises a superior type, the result of a fortunate and chance crossing rather than of intelligent selection. Such blind crossing of types produces only accidental excellence, and this excellence is likely to disappear in the second generation.

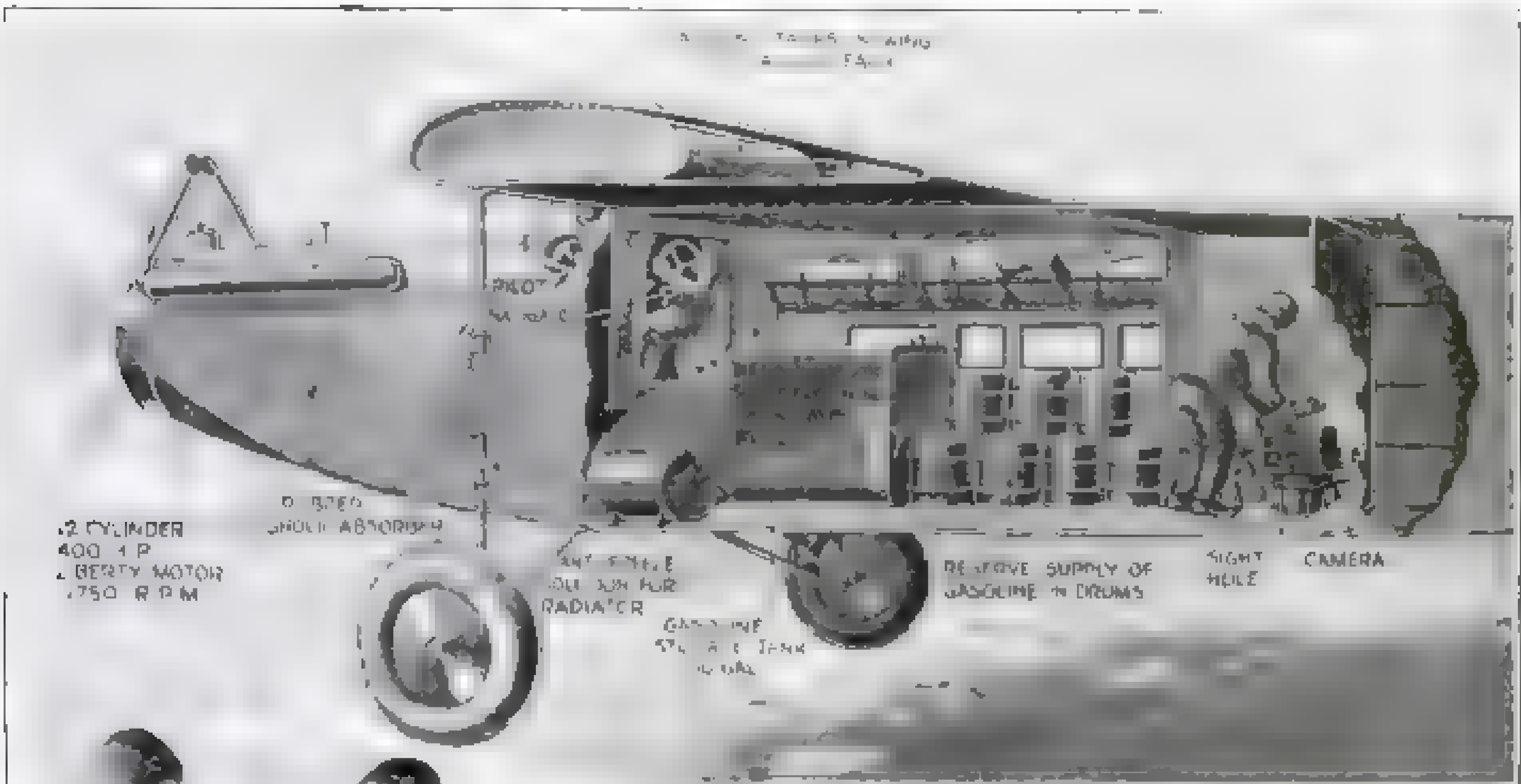
"Like plant development, racial improvement is a matter of heredity, selection, proper crossing, and environment. There is no great gulf between plant life and animal life. I know that plants have minds—subconscious minds, but at any rate, minds. In the work of human improvement we should begin where we begin in plant improvement—at the beginning, in the infancy of either plant or child.

"No child should see the inside of a school until he is ten years old. The only fit place to bring up a boy or a girl or a plant is in the country or in a small town. The atmosphere of a city is too artificial, too like that of a hothouse.

"The curse of modern child life in America is over-education. We do not expect a normal plant to begin bearing fruit a few weeks after it is born. Both the child and the plant should be given ample time to prepare for the work of their lives. To improve the race, the children of the race must be healthy. I could not work successfully with diseased plants that would spread disease among the other plants.

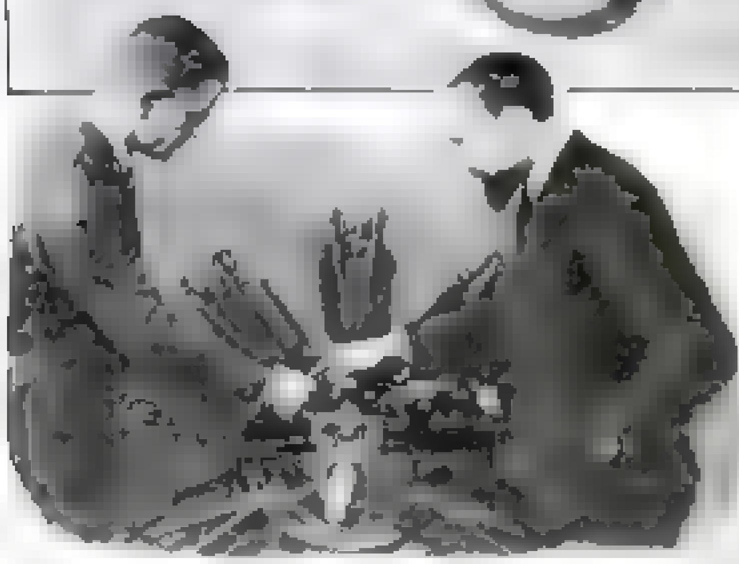
(Continued on page 129)

Airmen Poised for Dash to Pole

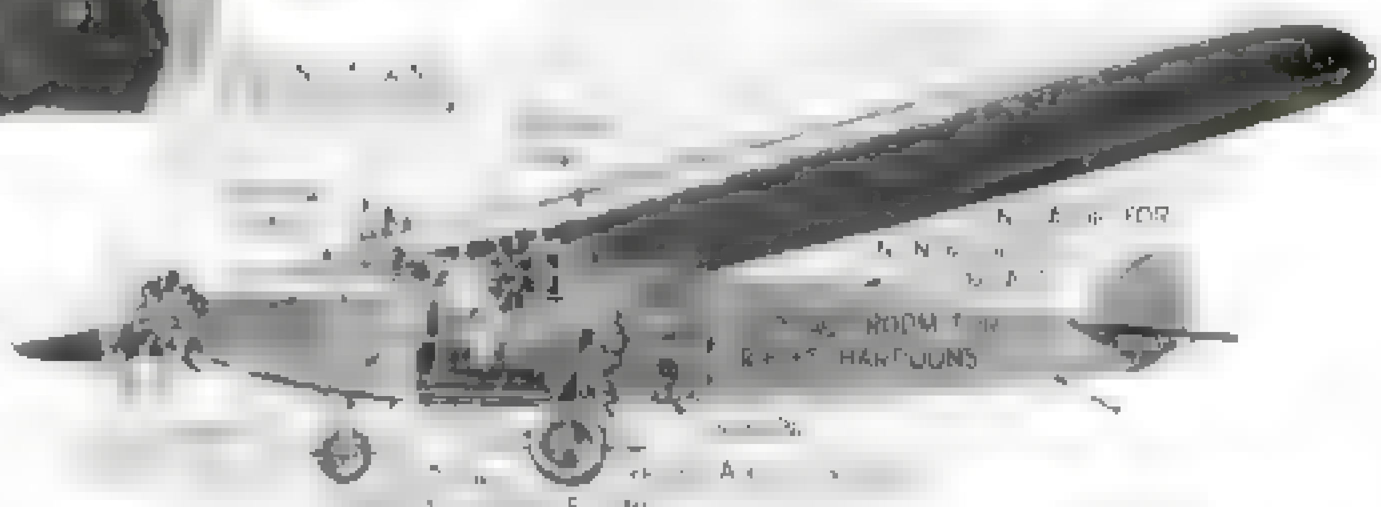


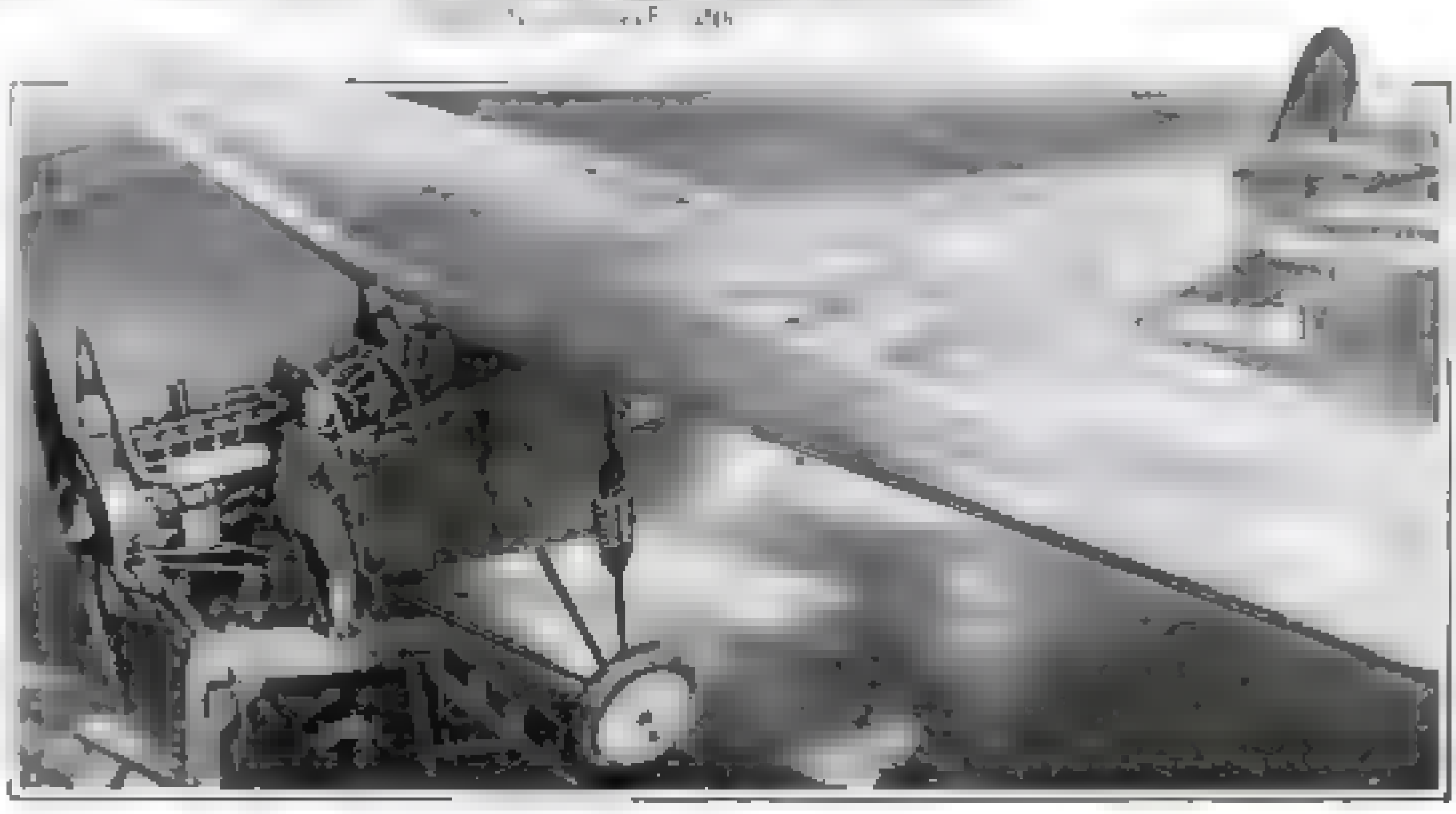
This cross-section of the supply plane drawn by our artist shows the gasoline stored in [illegible] tanks and drums that can be [illegible] transferred to the bigger plane. The [illegible] elaborate [illegible] equipment for [illegible] [illegible] by a single Liberty engine. In the photograph [illegible] of the page [illegible] the plane [illegible] for [illegible] hazardous flight

On the giant Fokker monoplane, sketched below, the success of the expedition depends. The great plane is [illegible] by three powerful [illegible] Whirlwind engines and carries a huge [illegible] fuel tank [illegible] 80 [illegible] gallons



Captain George H. Wilkins [illegible] [illegible] one of the great [illegible] Whirlwind [illegible]





UNDAUNTED [illegible] failures of Amundsen and MacMillan to explore the North Pole [illegible] the Detroit Arctic [illegible] Society's arctic expedition commanded by Captain George H. Wilkins, is prepared, as this [illegible], to hop off from [illegible] supply base at Point Barrow, Alaska, for a spectacular dash in which they hope to discover new lands at the top of the world.

They [illegible] giant monoplanes [illegible] here. One [illegible] supply plane [illegible] to transport gasoline from Fairbanks to Point Barrow. The other, [illegible] by triple "Whirlwind" engines, will attempt the [illegible] dash across the Pole [illegible] Spitzbergen.

Wilkins and his men will carry only two days' provisions. In the event of a forced landing, they will "live off the land," hunting seals and birds for food

Find the Mistakes *in* This Picture—$1000 Cash Prizes

JOHN and Mary Newlywed are getting an early start in trimming their yard. Here we see John in his workshop, sharpening the lawn-mower, while Mary is outside trimming shrubbery. John or Mary or both are doing, or have done, one or more things in the wrong way. In addition, the artist has made a number of mistakes in drawing the picture. How many mistakes can you find?

IN THIS, the second of a fascinating new series of monthly Picture Contests, POPULAR SCIENCE MONTHLY offers $1,000 in cash prizes to the readers who prove themselves to be the most wide-awake and observant.

If you tried your hand at the first $1,000 Picture Contest of this remarkable series in last month's issue, or if you are one of the thousands who entered our great $10,000 "What's Wrong" contest last summer, you will need no introduction to John and Mary Newlywed who play the leading rôles. You will know, too, how to tackle the problems presented by the Newlyweds in the picture on this page.

If John and Mary are strangers to you, you can look forward to the most enjoyable and worth-while competition you ever have entered—worth-while not only for the chance of winning a big cash prize, but for the opportunity of testing your mental alertness and of gaining practical ideas that you can apply in your own home.

See What Others Have Done

BEFORE you start work on this contest, turn to page 55 and look at the photographs of leading Grand Prize winners in our great $10,000 "What's Wrong" contest which closed last fall. Read how these other men and women won prizes in a similar competition.

In the first place, this month's contest is a complete competition in itself. To compete, you need not have entered any one of our previous Picture Contests. In fact, this Picture Contest is open to everybody, everywhere.

The idea of the contest is simply this: Each month we are printing a new, carefully-

planned picture of John and Mary Newlywed busy at some odd job about the home. In the picture, either or both of them are doing or have done one or more things in the wrong way. In addition, the artist has made a number of errors in drawing the picture. You are to see how many of these mistakes you can find.

THE $1,000 in cash prizes, sixty-three in number, will be awarded to those readers who point out the largest number of mistakes of any kind in the picture, and who present their explanations of the errors in the clearest and most skilful way.

Before you begin work on the contest, read carefully the rules below on this page. Then study the picture closely, examining every detail in John's workshop. See if you can find out what things are being done wrong or have been done wrong. What objects have been drawn incorrectly by the artist?

As you discover the mistakes, jot them down on paper. Ask other members of your family, your friends or neighbors, to join with you in the game.

The Prizes—Will You Win One of Them?

POPULAR SCIENCE MONTHLY is awarding $1,000 in sixty-three cash prizes for the best answers submitted in the fascinating contest described on this page. The cash prizes will be distributed as follows:

First Prize	$ 500
Second Prize	100
Third Prize	50
10 Prizes, $10 each	100
50 Prizes, $5 each	250
Total Prizes	$1000

When you think you have discovered every mistake, copy your list of errors neatly with pen and ink or typewriter, including with each answer a brief statement of what is wrong, and why it is wrong. Number your answers in order.

Remember to write on one side of the paper only, and to write your name and address plainly on each sheet of your contribution. Then address your entry to the Picture Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth avenue, New York City.

You need not hurry your answers, for you have until April 30 to get your entry into the offices of POPULAR SCIENCE MONTHLY. Perhaps, if your knowledge of tools is limited, you can get some friend who has had experience as a mechanic to help you. You will find any number of ways to check up on the mistakes in the picture.

REMEMBER that even if you should fail to win one of the cash prizes in this month's contest, there will be another similar $1,000 contest, with a brand-new picture, in next month's issue. The practice you gain now will give you an even better chance to win next time. Remember, too, that if you win a prize this month, it does not bar you from winning another cash prize in next month's contest.

Now turn again to the picture on the page opposite, and see how many mistakes you can spot at first glance!

The Rules of the Contest—Read Them Carefully

1. Each month, until further notice, POPULAR SCIENCE MONTHLY is printing a picture of John and Mary Newlywed doing some simple job about the home. Each picture shows John or Mary, or both, doing one or more things in the wrong way and, in addition, there are a number of deliberate mistakes by the artist in drawing the picture. You are to tell us what things are being done wrong and what things are drawn wrong in each picture, and why they are wrong.

2. POPULAR SCIENCE MONTHLY will award $1000 each month in 63 cash prizes for the best answers giving the greatest number of mistakes in the picture. These cash prizes will be distributed as follows:

First Prize	$500
Second Prize	100
Third Prize	50
Next 10 Prizes, $10 each	100
Next 50 Prizes, $5 each	250
Total Cash Prizes each month	$1000

3. Prizes will be awarded to those persons who point out the largest number of actual mistakes found in the picture and who present their explanations of the errors in the clearest and most skilful way. Actual mistakes shall be construed in all cases to mean mistakes appearing in the picture about which there can be no question in the opinion of the judges. In case of ties, the full amount of the prize will be given to each tying contestant.

4. Answers to each picture must be mailed or delivered to the offices of POPULAR SCIENCE MONTHLY not later than the thirtieth of the month following the date of publication of the magazine in which the picture appears. Thus, to insure consideration in this month's contest, answers to the picture in this month's issue, published March 10, must be mailed or delivered not later than April 30. No entry bearing a postmarked date later than the closing date for entry will be considered.

5. Answers may be submitted on any kind of paper, but they must be typewritten or written in ink, and on one side of the paper only. Each error must be listed separately and numbered. No changes or corrections will be allowed in any entry after submission, but any contestant may submit as many separate entries as he desires.

6. All entries should be addressed to the Picture Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth avenue, New York City. Name and address of the entrant must be written plainly on each page of the entry. Entries with insufficient postage will not be accepted. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be acknowledged and none will be returned. No letters of inquiry regarding points covered in the rules can be answered.

7. You pay nothing. Just prove your knowledge and observation. You need not buy POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend or you can examine one at any office of POPULAR SCIENCE MONTHLY or at public libraries free of charge. Each contest is open to everybody, except employees of POPULAR SCIENCE MONTHLY and the Popular Science Institute of Standards and their families.

8. Officials of the Popular Science Institute of Standards will act as judges and their decisions will be final. Acceptance of these rules is an implied condition of each entry.

Another Contest Next Month

THE third $1000 Picture Contest of this remarkable series will appear in next month's issue. Watch for it. Other similar contests will appear in succeeding issues of POPULAR SCIENCE MONTHLY. *Each will be a complete contest in itself. Thus, if you should fail to win one of the prizes one month, you always have as good a chance as any one to win a prize the next month.*

Have YOU a Double?

If You Resemble a Great Man, You May Be a Distant Relative

EVERYONE has at least one double somewhere in the world, and doubles are always blood relatives, though they may be extremely distant ones. These recently announced theories of Professor van Benanelen, of Groningen University, Holland, are attracting wide attention in Central Europe.

In every case of striking physical similarity studied by the professor a common ancestry was proved. According to Professor van Benanelen, if you resemble closely one of the world's great men you can properly claim blood relationship. He points out, however, that this is not strange, since if one goes back eight generations a man has 256 ancestors, and in thirty generations 1,000,000 forbears.

Attracting almost as wide interest are the experiments of Dr. E. O. Manoloff, of Russia. By color solutions and blood tests, this savant has been able to diagnose with startling accuracy the dominating racial ancestry of men he has never seen. At a recent clinic he examined blood samples from 202 persons of various races and nationalities, and diagnosed correctly the race of 187 of them.

Like the Great Emancipator

Judge Charles Bull of Reno, Nev., is a second Lincoln in looks, height and weight. He is six feet four inches tall, weighs 185 pounds, and has facial marks strikingly like Lincoln's.

A Prince at Least in Looks

Many doubles of the Prince of Wales have been discovered, but the one said to resemble the Britisher most closely even to his smile, is J. A. Garrow, an assistant purser on a great ocean liner.

Mistaken for Harding

When the late Warren G. Harding was president George de Papale, of Brooklyn, N. Y., was often pointed out by startled passers-by as the chief executive. The picture above shows him in an attitude reminiscent of President Harding in repose. Since de Papale probably has a million ancestors thirty generations back, blood kinship is possible, says a scientist.

Are Chimney Sweep and Kaiser Cousins under the Skin?

The uniformed figure at the right is not the ex-Kaiser in the height of his power, but a chimney sweep of the village of Langenbielau, Silesia. Max Nitschke. His close resemblance to the former German ruler is startling. The photograph shows Nitschke in one of the ex-Emperor's favorite roles, as commander-in-chief of the Imperial Navy.

Recalls Our War President

The resemblance of James R. McCabe, a Brooklyn attorney, to Woodrow Wilson has been commented on often. According to the Dutch scientist's theory, the similarity in physical features could be explained by common ancestry, if traced back

He Pawned *His Umbrella* to Give Us RUBBER

The Story of a Great Inventor's Winning Battle against Poverty

HE was called a fool, and was laughed at by his friends. Often he was penniless. But always Charles Goodyear said, "If it *is* to be done, it *must* be done, and it *will* be done." The result was a product which has revolutionized more than half of the world's industry

By ARCHIBALD DOUGLAS TURNBULL

ON A rainy morning of the year 1836, a slender man, with a thick shock of hair and with eyes that gleamed beneath the heavy brows of a drawn face, rapidly approached the ferry-house in Staten Island. What he wanted, and had to have, was a trip across to the ferry to the city of New York—but he had no money

That does not mean that he had left home without his pocketbook; it means just what it says. He had not a cent in the world -and he was 35 years old.

He entered the ferry-house and stepped up to the ferry-master

"Will you take that umbrella as security, and give me a ticket?"

"Humph," grunted the ferry-master Then, after looking carefully at both the man and the umbrella, he added Well yes."

That penniless man, running for his boat, was absorbed in a long, heart breaking fight that was finally to revolutionize half the world's industry. His ceaseless experiments with rubber were to make him, at last the inventor of an amazing process which is today commonplace—vulcanizing. And yet it is quite possible that the kind hearted ferry-master—himself long remembered as Commodore Vanderbilt, founder of a colossal fortune—did not even know that the man he had helped out of a hole that morning was no other than Charles Goodyear.

"Will you take this umbrella for a ticket?" Good year asked Cornelius Vanderbilt, the ferry-master. The latter looked carefully at the man and the umbrella. "Well, yes," he replied. So, without a cent in the world, the inventor got to New York

TO GOODYEAR, being literally "broke" was nothing new he had been little else for ten years. What is more, like many a other inventor who is far ahead of his time, he had often been called a fool for his pains and laughed at by his friends and most of his family Even though he had had his little successes with gum-elastic, as it was called then, there were few who had the smallest belief in him or in his work.

This gum had begun to come into the United States about 1800, the very year in which Goodyear was born. Of course, it had been known nearly a century before that, and already it had been recommended as a material for erasing pencil marks. But by the nineteenth century, it was only at the beginning of its real history.

Goodyear's own start had been made in hardware. The firm of A Goodyear & Son founded in Philadelphia in 1824, probably was the first domestic hardware business in America. Beginning well the firm finally came to grief and failed, leaving a mountain of bad debts. In 1830, young Charles refused to go through bankruptcy and thus sacrifice the right to some of the firm's patents. Instead when his creditors pressed him for one debt after another he went to jail. There, while working away at a bench with his tools, he began his long series of experiments with rubber.

I HAD been interested in gum," he said afterward, "when I was still in school. Some thin scale, peeled off a shoe, gave me a hint that it might be used for a fabric, if something could be done to stop it from being so soft and sticky."

Rubber shoemaking already had been tried The trouble was that the shoes would not stand changes in weather Goodyear himself, after he got out of jail, filled the shelves of a little shop with rows of such shoes that attracted much attention in winter. But, when summer arrived, one July day was enough to make them a hopeless, smelly mess of dough. Not only Goodyear, but many another, was ruined by that defect. And, for a new experiment, he would have to wait a whole year to know what different kinds of weather might do.

There had been great excitement over rubber. At first it had seemed a regular bonanza and, in New England great factories had sprung up over night. But when the manufactured goods began to be thrown back upon the factories as worthless after the first heat, something like a panic was precipitated.

Goodyear found this out almost by accident While visiting a big plant in Roxbury, he picked up a life-preserver in which the valve seemed to him a poor one. He carried it away with him, and in a few days brought back a better valve, which he offered to sell the factory The manager liked the new valve, but had to admit that he could not buy it because he was tottering on the verge of failure, for the simple reason that rubber, as it was then manufactured, melted at about 100 degrees Fahrenheit

Find out how to get around *that*," he said, "and you will make your fortune"

FOR weeks Goodyear puzzled over the problem. There must be, he felt, some way in which rubber could be cured, or tanned like leather, so it would be unaffected by heat or cold.

"I was blessed with ignorance of the obstacles ahead," he said later, "and I was encouraged by reflecting that what is hidden or unknown will most likely be discovered by the man who applies himself perseveringly."

And so he began, in his own tiny house borrowing his wife's rolling-pin to spread his various mixtures on the inside of thin cloth, or between two layers, or in every other way that he could devise. At first he thought that the stickiness came from using turpentine as a solvent of the gum, so he tried alcohol. Apparently, his only satisfaction from this came in cutting his one helper, an Irishman named Jerry, out of a solid mass of gum which Jerry had painted all over his trousers just in time to have it dry solid and glue him to his bench!

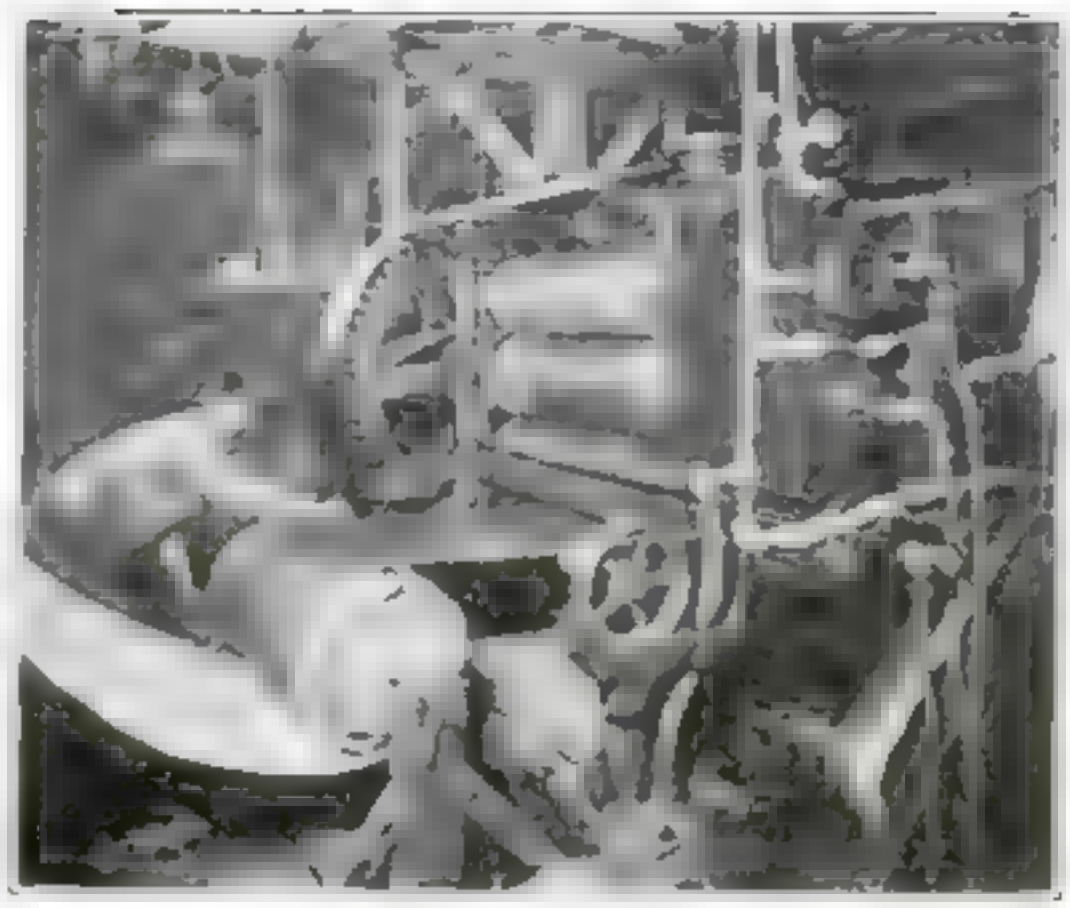
Still deeply in debt, Goodyear tried all his friends for more money One would lend him two dollars, another ten—only to have almost all of it go for new

experiments. At last the whole household depended upon what his wife could earn by spinning linen but still he persisted in thinking he was right. Making his way back to New York he got a friendly druggist, Silas Carle, to lend him some chemicals with which he went to work in a little attic in Gold street.

ONE of Goodyear's compounds was gum and magnesia. When this was boiled in lime-water, the surface of the rubber lost its stickiness, and Goodyear thought he had succeeded. He could make fine sheets of thin rubber, or small ornamental articles. Even that was such an advance that he was given medals, in 1835, by the Mechanics' and the American Institute. But he soon learned that if the new composition once touched vinegar or other acid, it became as sticky as ever the next instant.

"Not enough lime," he thought. So he used more and more lime until he nearly burned his hands off, without coming nearer what he wanted.

ONE morning he was ornamenting a piece of rubber with bronze. After dipping it in a weak lime-bath he touched the piece, to take off the extra bronze, with a pen forty, an impure nitric acid.



Its Predecessor Was a Wooden Rolling-Pin

In his early experiments Goodyear borrowed his wife's wooden rolling pin to spread out his various rubber mixtures. Yet this simple implement led eventually to the marvelous machinery which today supplies the world with countless rubber products. The picture above shows one of the huge rolling machines

Instantly the piece turned black whereupon he threw it on the floor under his work table a bit of worthless scrap.

But the look of it stuck in his memory. Two days later he was down on his hands and knees hunting for it. And then he had his first real reward.

Where the aqua fortis had touched the rubber, all the stickiness was gone leaving the surface fairly tanned. At once Goodyear followed up this clue, and in a few days he was producing thin sheets, well cured. Out of these he made aprons and tablecloths, which he printed in elaborate designs and for which he found a good sale. A certain William Ballard, of New York, came forward with a little money, the firm of Goodyear & Ballard was founded, and it looked as if all troubles were over. But, as luck would have it, the business panic of '36 came along, wiping out Ballard, closing the factory, and throwing Goodyear into the street again.

IT WAS then that he had to pawn his umbrella with Vanderbilt, to get from Staten Island, where his plant was, to New York.

The demand for rubber aprons fell off to nothing. Little by little everything the Goodyear family owned was either sold or pawned to keep them barely alive. Yet their few remaining teacups were filled every night with mixtures of gum, set to stewing over any chance coals that might be left. All night long Goodyear would stand at the stove, measuring, mixing, stirring and watching.

"If it is to be done it must be done and it will be done," he said. "Don't be seeing all the difficulties that may possibly occur.

Continued on page 1

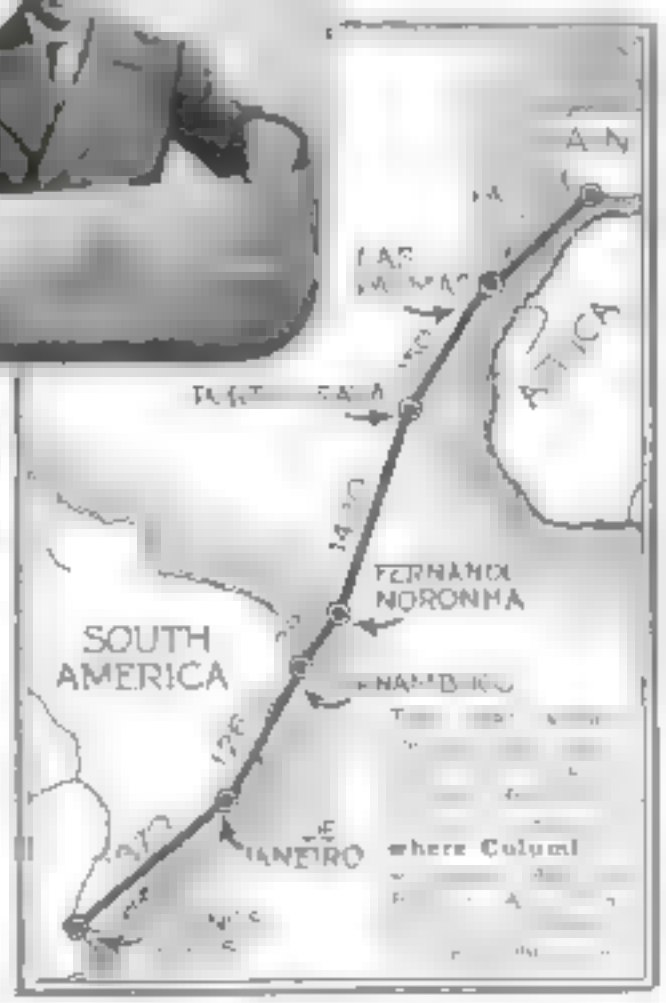
Spaniards Fly 3,500 Miles across the Atlantic

The First Sky Voyage from Europe to South America

ANOTHER dramatic conquest for the airplane as an overseas carrier has just been completed. For the first time in history fliers have succeeded in spanning the Atlantic from Europe to South America. From Palos, Spain, the very point from which Columbus set sail for the New World in 1492, Commander Ramon Franco and his comrades, in the Spanish seaplane *Ne Plus Ultra*, have traversed nearly 3,500 miles of ocean without mishap. Landing on the eastern coast of Brazil at Pernambuco they have extended their historic flight down the coast to Rio de Janeiro and Buenos Aires, rounding out more than 6,000 miles! This journey sixty-two hours and fifty-two minutes, considerably less than [illegible]

On their return flight these [illegible] to reach Panama, Cuba, and [illegible] to fly back to Spain by way of the Azores.

The accompanying map shows [illegible] and the stages by which the [illegible] The first hop was from Palos, [illegible] the Canary Islands, a distance [illegible] from Las Palmas to Porto Praya, Cape Verde Islands, 1,050 miles; then to Fernando Noronha, off the Brazilian coast, 1,480 miles, and to Pernambuco, 480 miles. Thence down the coast 1,200 miles to Rio de Janeiro and 1,370 miles to Buenos Aires.



News of the success of the flight was greeted with celebrations in Spanish cities. It was announced that the Spanish government plans the construction of an airport at Seville as a terminus for a direct airline between Spain and Argentina.

In a previous attempt to cross to South America made in 1922 by two captains of the Portuguese navy, two machines were lost and the journey was completed by steamer.

The Greatest Bridge in the World

HERE is presented our artist's conception of the greatest bridge in the world, which will span the Hudson River at New York City, uniting the shores of New York and New Jersey and providing a passageway for hundreds of thousands of motorists.

Its single span will measure two thirds of a mile, almost twice as long as the center span of the Philadelphia-Camden bridge, now the longest in the world. About twelve million automobiles a year, it is estimated, will pass over this massive bridge. There will be tracks also for electric trains and walkways for pedestrians.

The legislatures of the two states have authorized the bridge with the consent of the War Department and plans are now being worked out. O. H. Ammann, bridge engineer, and Professor William H. Burr of Columbia University will soon submit official designs. Cass Gilbert is to plan the architectural features.

The proposed bridge between Fort Washington, New York City and Fort Lee, New Jersey, will be of gigantic proportions, as our artist has indicated in this drawing. Four years will be required for its construction. The cost will be about $40,000,000. to be met by tolls. The New Jersey side at the proposed location is approximately fifty feet higher than the New York end. This may necessitate a cut through the solid rock of the Palisades

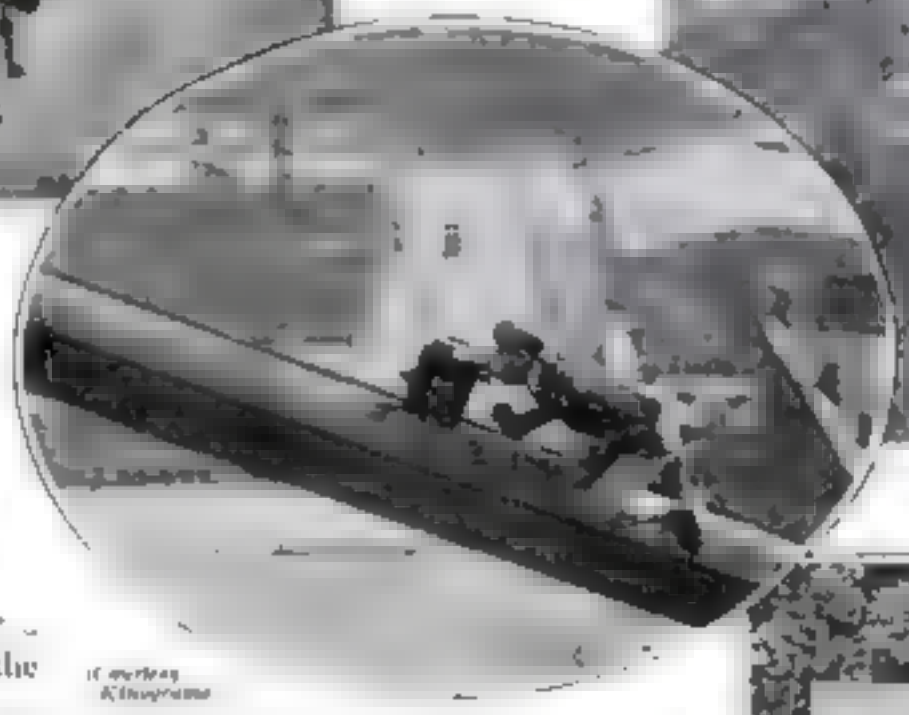
Taking Chances Is the Movie

Extraordinary Things Camera-the Thrilling Pictures

(Courtesy Pathé News

A perilous perch on a balloon captive balloon 400 feet in the air didn't worry the photographer who had started out to get pictures of the performing acrobats below

To shoot an eagle's nest high in the Austrian Alps, a photographer fought a soul-shaking battle with the mother eagle to get fifty feet of film. He was badly scratched and his clothes were torn almost to shreds, but he stuck till he won



(Courtesy Kinograms

Structural steel men are no more sure footed than the cameraman who crouched on a sky flung girder to catch a number of them while they were at work

News photographers must have steel interiors and brass exteriors. How one of them circumvented ex-Kaiser William's "no picture" order

By Robert E. Martin

THINK of anything whatsoever that men do—the sort of stunts that make the rest of us say, "Not me! Not for a million dollars!"—roll them all into one, and you have the news reel cameraman's job.

Stunt flying? Old time routine stuff for the cameraman! Submarine diving? Another "old timer" for the crank grinders! Cinching about on the sky-flung girders of a skyscraper, or on the top cables of some mighty bridge? Everyday work for the film men! The list goes on indefinitely.

The cameraman's soul doesn't shake. It hasn't even a shimmy left. Taking risks is his job.

"Look here, Harry," says the news reel editor, selecting one telegram from the pile of wires, newspaper clippings, cablegrams, penciled "tips," and phone memos that invariably decorate his desk. "Look here. Harry strikes me there's a picture in this. Read it."

Harry reads aloud:

"Washington, D. C. Editor. Understand navy flying two blimps Hampton Roads, test flight. Purpose not divulged. Can get camera permit blimp or plane. Advise."

The wire is from the organization's Washington bureau. Harry gages it with the penetration of long experience.

"They're probably taking those babies to try out that new bomb-spotting gage. Guess it's a plane job, Chief. Can't see myself sticking to one or the other of the gas bags—they probably don't know yet which one they'll use for the bombs."

Harry goes—then and there. As with all staff cameramen on assignment, his preparations already have been made; his bag is packed, his film magazines are loaded, his expense money is waiting. He telephones his wife—"Blimp job; probably home day after tomorrow." From which you may see who are the real heroes of the news reel game.

The story of this particular bomb-test blimp flight is worth telling only because Harry, as he has since admitted himself, made an error in judgment. He took a fast plane, with a pilot whom he wasn't sure of, in place of a slower plane piloted by an old timer with whom Harry had flown many times before. Harry thus "took a chance"—which is vastly different from merely taking a risk.

The pilot—nameless, his identity purposely disguised—was over-anxious to make a name as a good camera flyer. Twenty miles out at sea and 4,000 feet up, the two blimps buzzed along, rapidly nearing the test area. The plane bearing Harry was faster than the gas bags; the pilot flew ahead, circled, and came up from the rear, thus keeping approximate pace. The signal flag broke out from the forward blimp, telling Harry and his pilot that she would be the first to drop bombs.

Harry, in the rear cockpit of the plane, stood up. He slipped his camera crank in place, once more tested the machine-gun mount on which his camera rested, and signaled the pilot to get close. Focusing on the bomb gondola of the forward blimp, Harry began to grind.

Harry tells the story best.

"We're about two hundred yards from the blimp when I start to grind. She drops her egg—one of these big T N T. babies—which ought to be a signal to my pilot to dive under, then straighten out,

News Man's Job

Reporters Must Do to Achieve You See on the Screen

(Courtesy Pathé News)

To get an unusual shot of the crowd below, an intrepid news man was suspended on this narrow, shaky staging from a tower of Westminster Abbey in London

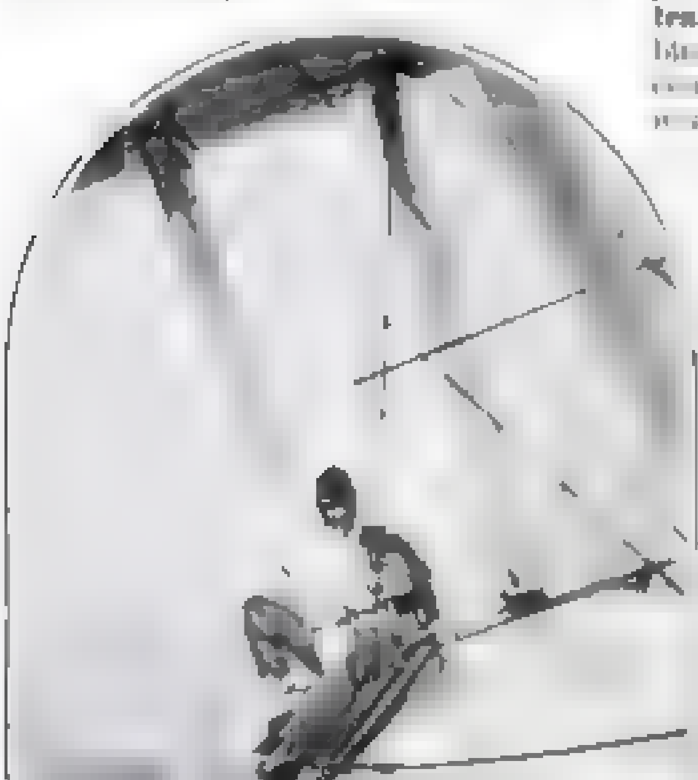
so I can shoot over the side for the blow-up on the target below.

"But he doesn't. Seems he never flew a camera before, and the one thing sticking in his crop is to get close so I can get a picture! Get that! So, in a split-second, I change my pleased expression. I'd been saying to myself, 'This boy's all right.' When the two hundred yards evaporate to twenty yards, I close my eyes, thinking, 'Well, here's one bird I won't fly with again.'

"I'm here, and that bird's some place around, too, I suppose, because he came to just when we could see the whites of their eyes in the gondola. He flipped our bus into a side-slip—the old Immelmann, you know; like turning a dish on its edge.

"Nobody minds a side-slip—if they know it's coming. I didn't know—I was already figuring myself as a daisy-pusher. Instinctively I grabbed out as we slid under the blimp on our right wing—and what must I grab but the machine-gun mount release clutches! Of course, the plane goes into a nose-dive—the only way out from an Immelmann, and there I am, doing a dizzy dervish dance, whirling around in the cockpit, with my legs tangled up in the tripod.

"Well, this so-called pilot manages to straighten out in two thousand feet, with us so close to the water we could call the fish by their first names. The navy observation planes beat us home; and when we landed, I didn't even have to open my mouth. The other pilots and the field commander were there with lots on their minds to say to this bird—not about risking himself, the plane and me, but for nearly tearing a hole in their beloved blimp. Boy, oh boy—when the commander of that blimp came around and got after my pilot, you could see the skin peeling off his ears."



Seated on the edge of an airplane wing, this photographer of celebrity [illegible] his camera to catch some of the thrilling stunts of daredevil aviators

Not every picture requires [illegible]. Newsreel editors are [illegible] and [illegible] at [illegible]. Brass tempered with discretion is often [illegible] best asset.

"No pictures desired" are familiar words to the seasoned cameraman. During the last years of Woodrow Wilson's life, the Washington cameramen [illegible] the [illegible] almost daily. The newsreels were not getting results demanded by their editors, and one of them saw that the situation offered a pretty chance for a scoop.

Police and secret service men guarded the Wilson home. They knew the Washington cameramen, and they meant to bar them. But one man tucked himself away inside a milk-wagon making early morning deliveries in the Wilson block. Opposite the Wilson house, he slipped out, and climbed a tree with his camera on his back. As best he could, he [illegible] himself to the tree, and worked his camera into position to face the doorway.

THERE the cameraman waited, stiff and cramped, for two and a half hours. The door opened. Three men appeared, two supporting between them the bent figure of the former President. Slowly he walked to a waiting automobile, and [illegible] away. But above, in the tree, the cameraman had ground out a scoop!

Defying threats on his life, the cameraman at the right took some fine shots of riot scenes during the strike in West Virginia coal fields

Courtesy Fox News

Behind every working newsreel cameraman is organization, money, help, direction. There are four American news reels. Each employs home-office staff men, operating in New York, and out of New York on "big stuff." The reels also have staff men in the larger cities—Boston, Chicago, Los Angeles, San Francisco, and so on. Altogether, the news reels average thirty to forty staff men in the United States. In addition, they have cameramen correspondents in nearly every city.

Each reel, of course, has staff men and offices abroad. London, Paris, Berlin and Rome are frequent sources of important news. The Orient is covered by traveling staff men, or sometimes by contract with native cameramen.

It is a noteworthy fact that staff men of all four weeklies are largely veterans of the game. They know [illegible] amazing number of [illegible] They know, too, how each [illegible] figures likes—or doesn't [illegible] publicity.

Of them all, the Prince of Wales tops the list as a "good fellow." On his never-to-be-forgotten Long Island visit the Prince "ducked" but he played the game like a sportsman, and finding himself under a lens, surrendered gracefully.

In Buenos Ayres, the Prince stepped ashore in formal regalia, escorted with all possible pomp. As he passed close to the camera brigade, he cast a quick glance over the group. Not a flicker of recognition did he show—until the cameramen stopped grinding. Then he turned back.

"Hello, everybody," he said. "Glad you fellows are with us. Hello, there, Jake—" and so on, like the regular fellow he is.

President Coolidge is known and respected by news reel cameramen. But he suffers, they say, from "lens shyness." It is not that [illegible] self-conscious; he has had far too much experience for that. But, old-time cameramen say, he is "camera-[illegible]" and therefore unconsciously [illegible]. Those who have known the President for years have remarked [illegible] that the popular impression of him as [illegible] what dour and unsmiling [illegible] wrong—because the President simply can't be just himself under a lens.

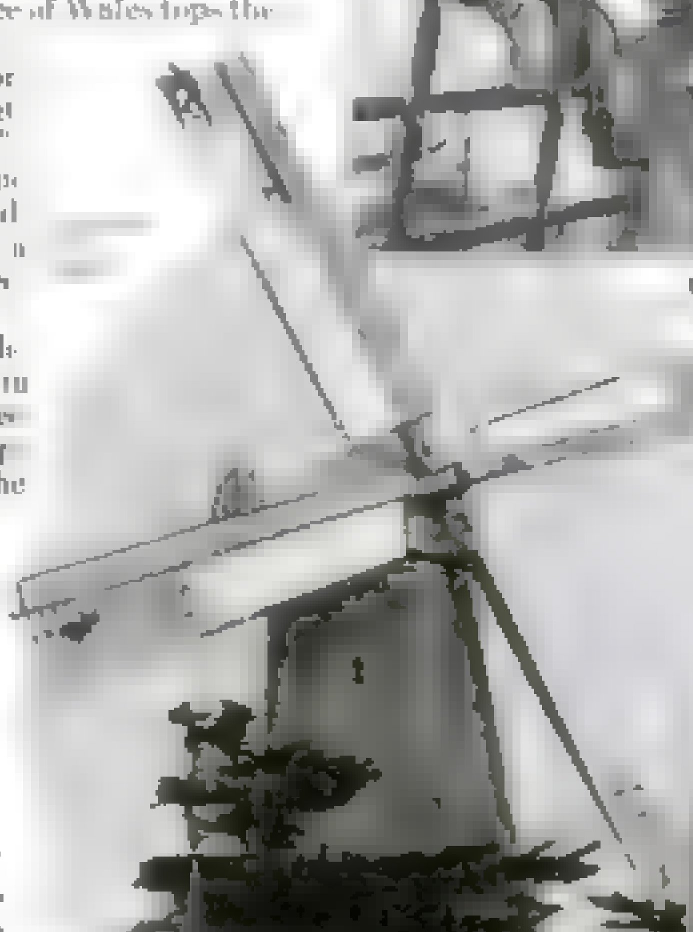
THE late President Harding [illegible] honors with Chief Justice [illegible] camera subjects par excellence. President Harding invariably [illegible] cameras as to no other [illegible] Taft likewise seems to [illegible] of peering far beyond [illegible] unseen millions who will be looking at him.

Another attribute of the successful news reel cameraman, in addition to fearlessness and brass, is shipping ability. He must be thoroughly versed in steamship sailings, train departures, available airplanes—wherever he is. His first job, upon arrival in another town, is to find out how to get his film back home fast.

On "big" stories—the recent Scopes trial in Tennessee, the Shenandoah disaster, the national political convention—airplanes are indispensable. They are the fastest available transport, and must be used.

When Woodrow Wilson stepped ashore in France on his visit to the peace conference, cameramen from each reel made the picture. It was an even break. The next steamer was to sail for New York two days following. One news reel editor arranged to have his film taken immediately upon a returning naval vessel; another shipped via a nine-day steamer for Canada. Both had figured well—but the naval vessel was turned aside from New York by the Navy Department, on pressing official business, and the nine-day boat was delayed by storms. The regular shipments arrived on time. Luck of the game!

[illegible]



[illegible]

Bill cameraman flew around the inner brim of Vesuvius, just to photograph the crater. Above is a picture of the famous volcano in eruption, which he risked his life to obtain from the air

Cameramen have shipped film as the personal baggage of travelers; they have dropped film (in life-preservers) from airplanes to waiting speed boats below; they have shipped by freight-caboose and by donkey-train. If someone will kindly invent a faster airplane, cameramen will [illegible] something still faster. Even now, [illegible] in progress, it is reported, [illegible] transmission of motion pictures [illegible] and by wireless, utilizing in an ingenious way the existing methods of still-picture transmission.

In airplane camera work, the real thrill [illegible] is in getting back home. An experienced airman, yclept Bob, admits that he received a slight thrill on a recent sky-writing [illegible]ment.

The writer-plane flew at approximately 10,000 feet over that well-known section of New York called Manhattan. Bob's plane flew above the sky-writer—three-[illegible]le above, so that Bob could get a [illegible] general view of the skyscrapers below, like a toy relief map, with the sky-writer doing his stuff above them. Furthermore, it was winter; up where Bob was, the Arctic would rate as a summer resort.

Bob made his picture; signaled his pilot, "All over"; and crouched down in his cockpit for protection from the wind. And just about then, the motor stopped.

"I looked forward to the pilot," Bob related afterward, "and he just flipped his hand. Not a cockpit signal, just a hand-flip. The old 'prop' was turning over easy from our own wind; so I sat down for a few deep and heavy thoughts. From time to time we would jolt and jounce through a run of air pockets; that helped make me feel better, not. All I could figure [illegible] of two things: the pilot either would chance a dip in the bay, or would run his chances on cracking up [illegible]d—the field we took off [illegible].

"[illegible] George's ferry house, on the [illegible] Staten Island, slips by under[illegible]s out and almost can [illegible]gles on the roof. 'Good-[illegible]' I'm thinking—and, [illegible] starts the motor. A few minutes later we land.

"'What hit our motor?' I ask this bird.

"'What's the matter with the motor?' he says, anxious. 'Wasn't she hitting all right?'

"'Just now, sure; but up on the ceiling, she didn't turn a flip.'

"'Oh, that. Why, I was just sliding in, with 14,000 altitude to start with. Think of the gas I saved! Didn't you ever hear of volplaning?'

"'You're Scotch, ain't you?' I ask him, sarcastic.

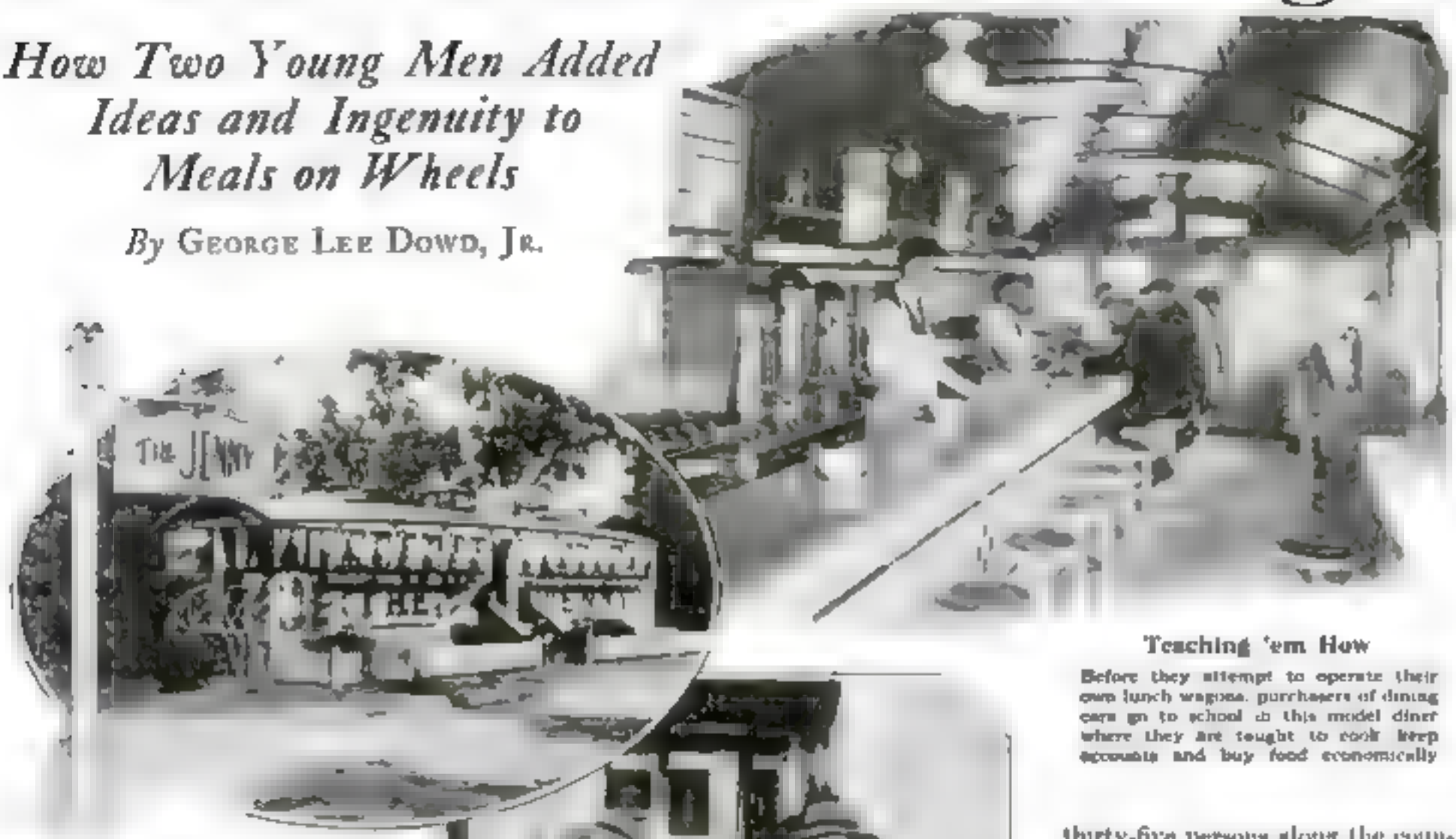
"'Certainly I am,' says this bird, serious, too. 'Who told you?'"

Any cameraman's experiences cover far more than "air stuff." Take the case of Carl, one of the dyed-in-the-wool veterans of the game; which, in the movies, means that (Continued on page 126)

Science Runs the Lunch Wagon

How Two Young Men Added Ideas and Ingenuity to Meals on Wheels

By George Lee Dowd, Jr.



They're All Dressed Up Now

This ornate dining car with its window curtains and flower boxes supplies a striking contrast with the ramshackle smelly "dog wagons" of other days

Teaching 'em How

Before they attempt to operate their own lunch wagons, purchasers of dining cars go to school in this model diner where they are taught to cook keep accounts and buy food economically

Modern Dining Car Was Their Idea

These two young men revolutionized the manufacture and operation of lunch wagons by standardizing production and teaching men how to run these restaurants on wheels. At their factory in New Rochelle, N. Y. Edward J. Tierney (right) discusses with his brother, Edgar T. the details of a newly designed diner

AT THIRTEEN "Charlie" Porter, of New Rochelle, N. Y., was the youngest licensed commercial radio operator in the United States. At eighteen, he joined the navy as a radio electrician. After four years of service at sea, Charlie was an engineer at a good salary for a New York radio concern.

And then, Charlie did a strange thing. He gave up his good job and went to work frying eggs and hamburger steaks in a lunch wagon!

His friends laughed.

"What's the idea, Charlie?" they snickered. "Throwing up a perfectly good job to shog 'ham and.'"

But Charlie just smiled.

That was about three years ago.

The other day, around noontime, I was at the busy intersection of First avenue and 125th street in New York. I spied on the southwest corner a large, shining, yellow car, bearing in large red letters the words, "Charlie's Diner."

Perhaps, if you are not too young, you will recall those picturesque old "lunch wagons" of, say, twenty years ago. You will remember the old nag that hauled the wagon to some promising vacant lot and left it there to pour forth its pungent odors. You may recall, too, the kerosene lamps that shed a foggy glow on the counter and the smoky stove.

I recalled these things, and was somewhat hesitant about approaching Charlie's diner.

To my amazement when I opened the door, the "dog wagon" of old, a place of smoke and grease, had been transformed into an airy, almost palatial dining car. Floors of spotless white tile, counters of marble and mahogany, chairs of white enamel, cheerful electric lights, electric fans, skylights, gas and electric ranges, electrically operated cooling system and refrigerator, porcelain dishwashing tubs with hot and cold running water and sewer connections—in short, a complete, inviting restaurant equipped with all modern devices for sanitation, convenience and labor-saving in the preparation and serving of meals. And all contained in a space not larger than a one-car garage!

Behind the counter stands Charlie Porter proprietor and boss. With him are two assistants, a chef and a helper.

"White or rye bread?" asks Charlie, as I look for a chair. There are seats for thirty-five persons along the counters, and nearly all are occupied. When Charlie has served me with a heaping dish of corned beef hash smothered in a poached egg, he informs me proudly, in response to my inquiry, that last year he netted $10,000, and that this year he expects to make at least $15,000.

Fifteen thousand a year from a lunch wagon sounds like another one of those "success" fables. Yet Charlie Porter tells you that while he has put in plenty of hard work and long hours, his success has been made possible not so much by his own individual enterprise as by the wonderful products of mechanical and engineering genius applied to the business of supplying people with clean, wholesome food at reasonable prices.

Dozens of other men, I subsequently learned, are doing just what Charlie Porter has done. They have seized the opportunity offered by a spectacular new industry born of the old-time "dog wagon"—an industry based on the utilization of compact mechanical devices to save time and labor in preparing and serving food.

A LITTLE metal placard on the front door of Charlie's diner led me to New Rochelle, N. Y., where I found two brothers, Edward J. and Edgar T. Tierney, both under 30, who by adding ideas and mechanical ingenuity to the "dog wagon," have reared it from a liability to a million and a half dollar dining car business.

Not content with building and selling dining cars to prospective operators, they also train and establish men in the lunch wagon business and show them how to make money.

To this end they have established one

of the strangest schools in the world—a lunch wagon training college where future proprietors are taught to wash dishes, scrub floors, cook, bake, order provisions economically, serve good meals without waste, and a hundred and one secrets of pleasing the eating public.

The history of their achievement goes back some thirty years to the nineties, when their father hitched his horse to one of the first "owl" wagons. He made a living at it. He was ambitious and handy with tools; so he began to build lunch wagons himself. A trip in a New York subway gave him the idea for the white tile floors. He saw the possibilities of electricity, gas, water and sewer connections and set the lunch wagon on a permanent location where these conveniences might be utilized for cleaner and better service twenty-four hours a day. He installed ventilators and skylights, and substituted electric lights for kerosene lamps.

Modern Efficiency in the Lunch Wagon Factory

The dining cars are built just like automobiles—from standardized parts fashioned by specialists and assembled as they are conveyed about the plant. Two weeks after the first nail is driven the wagon is ready for shipment, and in condition for long service

AND yet, with all his ingenuity, at his death seven years ago lunch wagon operation was still a haphazard affair. The business needed a reputation and a standard.

Surveying their inheritance, the two sons put their heads together. The result was the dining car training school—a fully equipped lunch wagon set up beside a well-traveled road and open to customers day and night. Here's how it works:

There comes to New Rochelle a bank bookkeeper who has decided there may be a future for him as a dining car operator. While his car is being built (a job which takes about two weeks), he starts in the lunch wagon school.

The first morning, at 7 o'clock, he dons apron and cap and learns how to mop the floor, clean the counter, shine up the nickel coffee urns and polish the spigots. At 7:30, he embarks on his first buying expedition. He is told the provisions needed for the day's business. He is to pay cash for them and bring them back. Returning by 9 o'clock, the chef introduces him to the mysteries of cooking. By 11 o'clock lunch is ready and he experiences his first thrill of serving customers. The midday rush extends well into the afternoon, then again the business of watching and absorbing the details of his new calling.

After that, he tries his hand at making up "hamburgers" (a favorite dish among lunch wagon patrons) for the night trade. And so the first day ends.

A week or so of this intensive training and the bookkeeper has mastered the little economies that may spell the difference between profit and loss, and has learned the kind of food and service that bring customers back.

At last his schooling is ended. The completed dining car stands on four steel wheels at the factory door, fitted with everything from spoons to mop handles, and he is ready to go.

But he is not left to shift for himself. Already, while he has been going to school, experts have selected a location for him that promises profits from the start—a selection based on a study of such factors as the automobile traffic and the number of pedestrians who pass his door each day. For it is the passer-by, particularly the motorist who makes the lunch wagon pay.

At this location the new dining car is placed on a foundation and connected with sewer, electricity, gas and water service lines. An experienced manager helps the ex-bookkeeper get a license, hire a chef and a dishwasher, and stands by during the first difficult week of getting established.

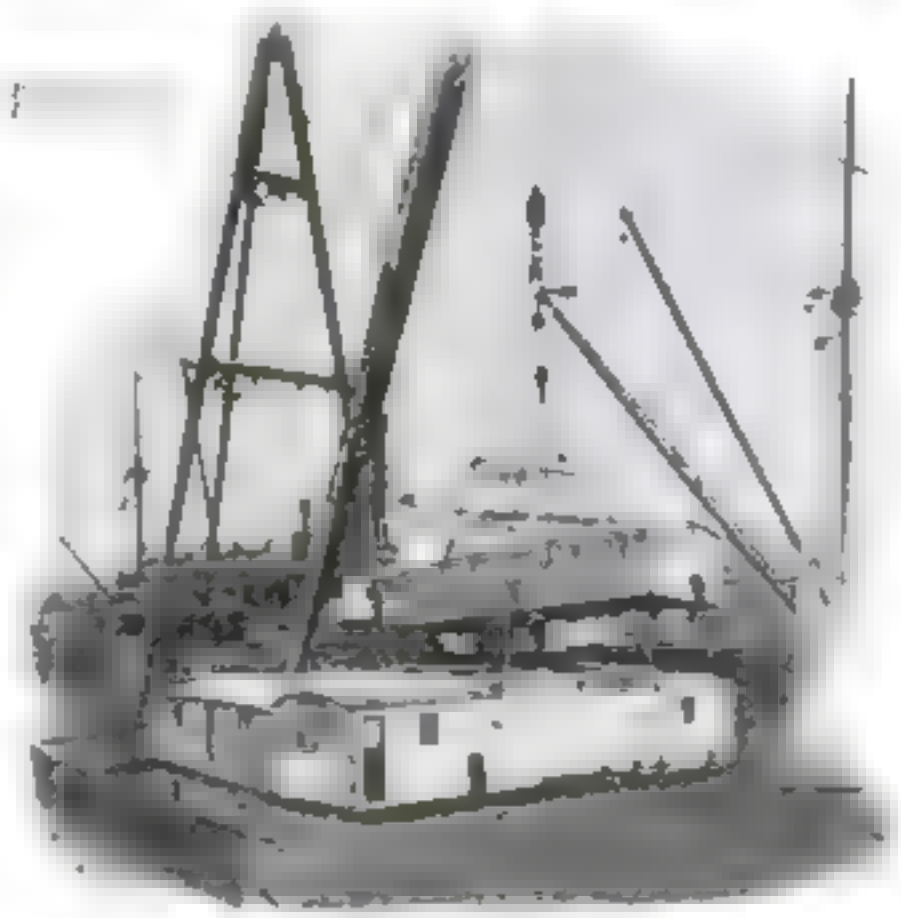
I had found the reasons for Charlie Porter's success. The dining car takes up little room; therefore the ground rent is small. There are no waiters; labor costs are small. Buying and selling are on a cash basis. Waste, usually a costly item in restaurant management, is cut to a minimum, and everything possible is done by mechanical devices.

IN THE manufacture of lunch wagons, modern methods of standardized quantity production have been borrowed from the automobile industry. All parts are of standard design and are turned out in large numbers. The plant I visited has a capacity of forty-six dining cars on the floor in various stages of construction. The work of building begins with a framework of four-inch steel H-beams set upon springs above four steel wheels. The frame moves forward on tracks to receive its body of oak sheathed with fireproof steel. At each step, a new part or fitting is added until on reaching the front of the plant it is complete in every detail.

Every day at least two new cars pass out of the factory. Today nearly 1,000 are in operation in many parts of the country, some as far west as California. This year Florida alone is getting 100 of them to fill the demand for eating-places.

The maxim by which this remarkable enterprise is guided is expressed by the two brothers as follows:

"Three times a day, 100,000,000 people in America get hungry. Three times a day, 100,000,000 people find somehow and somewhere those regulation three meals a day. We are simply in the business of developing a machine to provide those three meals a day for people who want good food well cooked, served promptly, amid clean and inviting surroundings and, in addition to all this, at a moderate price."



A Boatload of Diners for Florida

Ordinarily diners are towed to their locations by motor cars, or shipped by rail. Boom times in Florida, though, have brought such unprecedented demands for lunch wagons that it has become necessary to make wholesale shipments by water, which requires very careful handling

Old World Fishermen Win Wealth in America

The Italian salmon fishermen of the Golden Gate carry their 400 foot lines in rope baskets. Here is a fisherman coiling a line while keeping close watch for the hooks

The boats of the San Francisco salmon fleet are modeled after the old feluccas that Mediterranean fishermen used in catching the tunny. Gas engines have replaced the old lateen sails. In these boats may be seen the long poles employed in the new method of trolling which enables four men to catch in one day more salmon than eight men with ordinary lines or nets could take in two days

By NEWTON BURKE

ON THE San Francisco water front today you may find a fascinating bit of the picturesque Old World brought to America and made over into a thriving enterprise by the methods of science. There, huddled along the wharves, you may see a fleet of forty boats owned by a colony of Italian fishermen. Transplanted bodily language, customs, and boats—from the Mediterranean to the Pacific, these hardy men are reaping a harvest of wealth in shining salmon from the deep sea outside the Golden Gate.

In the little boats in which they fare forth into the Pacific, they have replaced with gas engines the lateen sails used for centuries by their forefathers. In place of old-time nets and hand lines, they have substituted long, springy trolling rods with which four fishermen now can bring in a larger catch in one day than eight formerly did in two. By the use of modern appliances, they have changed "fisherman's luck" into scientific skill that seldom fails. And as a result a single boat now averages $100 worth of fish at a trip—sometimes reaching as high as $300.

To learn the secret of their success, I went recently to the Fisherman's Wharf where this picturesque colony centers and there I was invited to spend a day with the salmon fleet.

It was not yet dawn, one fine morning, when I dropped down the iron ladder from the wharf to the deck of the *Ana*, and was warmly greeted by Antonio, its captain. Orders were given to start, and in a few minutes her engine was chugging lustily as we moved away from the pier. We were closely followed by other boats, for these Italian fishermen cling to the customs of their forefathers and never go out singly

The run across the bay was made, and the fleet shot through the Golden Gate.

As we headed for the high seas, the men prepared for the day's work. Under Antonio's directions they raised a twelve-foot mast and set in position two twenty-foot fishing poles. Each of these projected about fifteen feet beyond the boat and carried a 400-foot quarter-inch line, weighted with a twenty-pound sinker. At intervals of three feet for 150 feet up the line were leaders with hooks which they baited with Monterey sardines.

When all was ready, the sinkers were cast overboard, and the lines sang as they whizzed from the coils. The great rods shook. The boat slowed to a fast walk, and we were trolling the silver king in water probably 9,000 feet deep. The boat tossed about like a cork.

In a few minutes the man at the wheel shouted "Port rod! Port rod!" Then, "Both rods!" All hands rushed for the rods that curved down toward the water, and began hauling in the lines. A flash of silver and the first salmon landed with a slap on the deck. More pulling brought in half a dozen more weighing from twenty to forty pounds.

Picturesque boats of the salmon fleet brought from the Mediterranean. Note the long fishing poles tied to stubby masts

SO MANY times during the day, the lines were baited, dropped, and hauled in with from one to four fish each time. By three o'clock the *Ana* was filled to capacity and we turned back to port. As we came in sight of land, a humpback whale about twice as big as the *Ana* came up about 100 feet away from us, and by changing our course we just missed another.

As we approached the shore we joined the rest of the fleet, and a free-for-all race for the wharf began. By a great burst of speed we arrived first, and in five minutes Antonio was bargaining with fish buyers for the sale of $300 worth of silversides in the *Ana's* hull.

Drummond, one of the world's finest whippets streaking down the course at Rocky Hills near Sydney, Australia. A remarkable photograph of a nervous little racing machine game to the death"

Pound for Pound

The Fastest Thing on Legs

As a Sprinter, the Racing Whippet Beats Them All

By Arthur Graham

UNDERFOOT, the emerald-green turf of the fashionable Meadow Brook Club's practice polo field. In the background the deceptively unpretentious clubhouse and the bright blue stands erected for the last International Challenge Cup polo matches between America and England. Overhead an azure Long Island sky flecked with white clouds. Clustered about the field watching the preparations for the day's events groups of be-flannelled or smoked-back ered men and sport-attired women

A perfect picture of the sort of expensively simple outdoor life in America that requires a lot of intensive indoor effort to support it!

But today it is not rich man's polo, but what used to be exclusively a poor man's sport, that these wealthy members of New York's famed sporting club have gathered to watch. In the center of the field, a 200-yard straightaway course has been measured out. It is like the course for a sprinting race: tight-stretched white cords giving each contestant his own lane and freedom from interference. But no Paddocks or Morelusons crouch at the starting line. Instead, five men stand there restraining with sure-acting slip leashes five little dogs that are eager to run. Behind them stands a sportily dressed individual with a pistol

Walking backward down the lanes from the starting line are five other men, who call continuously to the dogs and wave handkerchiefs or towels. Still shouting, they cross the finish line 200 yards away and take their places on the "tag" line ten yards behind it.

"Ready!" asks the man with the pistol

The figures of the men on the starting line grow tense, the five little dogs their eyes fixed on the white cloths waved provokingly behind the finish line, whine their eagerness to be off. The starter raises his pistol. The five men sway the dogs back gently. At the bark of the pistol they swing them forward again, throwing the dogs into their strides, at the same instant releasing the "slippers" at neck napes and tail roots.

There is a shout from the spectators, a miniature of the thunderous "They're off!" of the equine race track. The voices of the men become the finish line roar, command implore. Eyes and interest on nothing but that white cloth waving in the distance, paying no heed to the

Slipping the Leashes—an Instant's Delay May Spell Defeat

They're off! At the crack of the starter's pistol, the "slippers" throw the dogs into their stride. This picture shows the flying start of a whippet race at Santa Barbara, Calif. The woman at the right is Mrs. Chris Shuttleworth, of Santa Anita, the most famous of slippers, as a pose familiar to whippet fans

rivals, each tiny racing machine tears down its lane, slim body stretched close above the turf, long legs working at top-speed, compact little feet seeming scarcely to touch the ground, long rat-like tail acting as a balancing rudder.

Another excited shout from the spectators. The dog wearing a red collar has gone into the lead. Twelve seconds after the pistol shot, he crosses the line with a yard to spare, leaps high in the air, tears the towel from his handler's grasp, worries it with mock ferocity. The handler catches the excited animal by the collar, caresses it with the gentle roughness that all dogs love, speaks words of praise with the broad accent of Yorkshire.

A Rag-Tearing Free-for-All at the Finish

The exciting finish of a whippet race at Princemere, Mass. Leaping across the finish line, each dog tears the towel from the grasp of its handler or "runner-up," then worries the white cloth with such ferocity that almost rivals the attack of a hungry wolf pack

"TWENTY pounds of running!" he says to a bystander. "Game to the death is a good whippet, and pound for pound the fastest thing that goes on two legs or four."

Trustworthy data on the speeds of wild animals in their native state at present is lacking, but probably if tests could be held they would bear out the whippet enthusiast's contention that, size considered, the whippet is the fastest animal that runs—provided the running is done over a course of 200 yards. It has been proved in many coursing matches that a wild rabbit, given thirty yards start on one of these dogs, is doomed to certain destruction.

A good whippet, well trained, can run 200 yards in twelve seconds. This means that the little "race dog" travels at an average speed of slightly more than sixteen and one-half yards a second. The racing greyhound, the whippet's big brother in dogdom, runs faster than that, but if handicapped according to size—which would give the whippet a start of ninety yards in a 400 yard race—the whippet would prove the faster. But whippets and greyhounds never are run together, for if the greyhound should overtake his smaller brother he would be likely to mistake it for a rabbit, and someone would be short a valuable whippet.

Comparison of the whippet with the human runner makes the world's fastest sprinter seem slow. Charley Paddock's record for 200 yards is nineteen seconds—an average speed of about ten and one-half yards a second. A good whippet could give Paddock a handicap of sixty yards in a 200-yard race and beat him so easily that the finish wouldn't be exciting! The highest speed ever attained by a human runner—about eleven and one-half yards a second, in the second fifty yards of a record-equaling 100 yard race—doesn't compare favorably with the pace of these little dogs that are bred for running and nothing but running.

Even where he is supplied with mechanical aids, the human athlete would have little chance against a whippet over the dog's favorite distance. The 200-yard record for ice skating is more than five seconds slower than the standard time for whippets. Frank Kramer set a world record by riding a bicycle a quarter of a mile in twenty-eight and two-fifths seconds. If a whippet had been running against the cyclist on that occasion, the dog would have passed the 200-yard mark with a lead of at least ten yards.

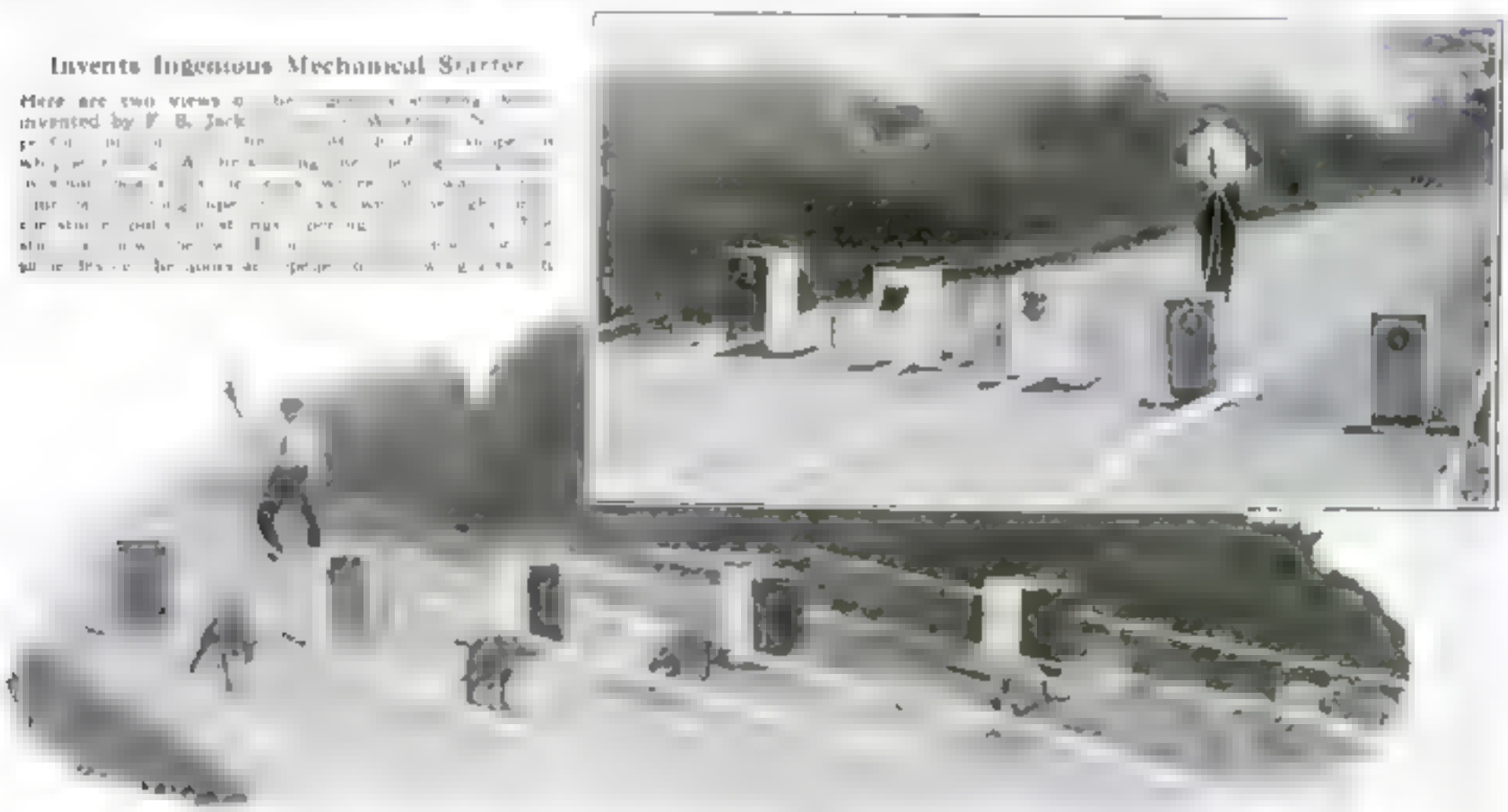
ALL OF which shows that whippet racing is a speedy sport—and explains why it is becoming a popular sport in many parts of speed mad America.

Although in the United States whippet racing has

(Continued on page 141)

Invents Ingenious Mechanical Starter

Here are two views of the [illegible] invented by F. B. Jack[illegible]



Millions in a Convict's Oil Well Invention

Inventor of Drill

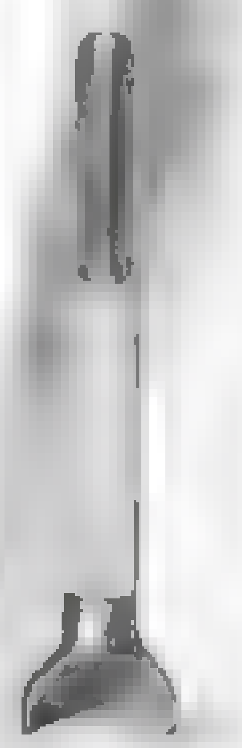
C. L. Skinner, convict No. [illegible], San Quentin, Calif., whose new [illegible] [illegible] of [illegible] [illegible] millions from [illegible]

By

H. C. DAVIS

The Ordinary Rotary Drill

Outfit employed in rotary drilling is seen above. Skinner's invention, an improvement on this, may save $10,000,000 a year now lost in oil fields in the United States when tools break and are left in the borings



[illegible]

TWO years ago C. L. Skinner of Los Angeles, was sentenced to four years in San Quentin prison, in a tangle over a check. He was just one of a thousand oil well drillers in Southern California. Today, he is the inventor of a device for which a large oil company has offered half a million dollars cash, another $250,000 cash and 20 percent royalty, and a third 30 percent royalty. He expects his invention to pay him from ten to twenty million dollars in the next ten years.

The invention prevents the loss of tools, such as bits and drills, used in the rotary drilling of oil wells. It will mean a saving to the American oil industry of ten million dollars a year, according to Skinner and other experts.

Skinner had always considered this tremendous waste necessary, and, until he entered the penitentiary, had never thought of trying to prevent it. Alone in his cell one night, he hit upon an idea and worked out a model in his spare time. Subsequently Warden Frank J. Smith and other officials gave him the use of the prison shop and of tools, to perfect the invention.

Oil wells are drilled by the "standard" method by which the hole is driven by the pounding of huge steel bits, weighing up to five thousand pounds, slowly raised and lowered by means of a walking beam, and the rotary method, by which a smaller hole is drilled by the constant turning of a line of pipe with a bit at the lower end. Skinner's invention is intended for rotary drilling, which is gradually supplanting the first-named or "standard" method.

His rotary drill consists of sections of cable, inserted into sections of pipe, each end of the cable being molded into a cap threaded at the outer end, and fitting at each end into a collar, with holes through which the water used in the drilling, and the mud pumped out, may pass as freely as through the pipe itself. On the outside of this collar, at one end of the pipe section, is a threaded standard and at the other end a threaded socket so that, when the sections of pipe are screwed together, these threaded holders

Distinctive Parts of New Drill

At the top, above, is one of the sections of C. L. Skinner's invention, and, below, the cutting bit which is attached to the cable

of the cable also engage each other, making a continuous cable running throughout the pipe, from the surface of the earth to the bottom of the well. At the bottom the lower section of cable threads into a socket on the upper end of the drill or bit.

In the old type drill, only the pipe sustained the tools in the hole, and if the pipe broke under the strain of the twist put upon it by the rotary drilling machinery, the tools were lost. Frequently they were never recovered, remaining in the hole to prevent further drilling and so necessitating loss of the well and removal of the drilling rig to another site.

EVEN when they were recovered, much time and labor were lost, adding materially to the cost of the well, which, even when drilled under the most favorable conditions and without accidents, varies from $80,000 to $125,000.

Skinner's invention, however, insures that the cable remain intact, even should one or more joints of the pipe break, so that mere pulling out of the pipe rescues everything and leaves the hole clear for the insertion of new and unbroken pipe and tools. The cable runs from one half inch to one and one half inches in size, and is of specially woven steel threads.

After the well is completed, this new type of drill may be withdrawn and used in another well, or may be left in and the oil pumped through it. Its use in another well, however, considerably reduces the cost of drilling.

It is estimated that the cost of equipping the drilling-pipe with this new type of cable will be about a dollar a foot

Tests You Should Make B*efore* Buying Your House

How to Be Sure of Your Money's Worth

By John R. McMahon

This is the second of an unusual series of articles on home building by a nationally recognized authority. In his next article, Mr. McMahon will tell how to obtain a house at least cost—an old house remodeled.

"HELLO, old scout. This is Tom speaking. Say, Margery and I have picked out a house that we think we'd like to buy. But we want you to give it the once-over first and hand us your expert opinion whether the shack is all that it looks to be. Sure. Right away, if you can spare the time. It's my day off, y know. Good. Thanks. We'll drive along in the old fliv in half an hour and pick you up. G'by."

I really had some work of my own to do, but I couldn't refuse to help out such a nice young couple as Tom and Margery. He has a city job, and she's one of the best little housekeepers that ever concocted lemon pie. They had been saving their money for three years to buy a house. We had often talked over the subject of money's worth in a dwelling, and how to tell sound construction from the other kind. We had "window shopped" for homes many times, on the ground and in pictures. Now they were set to buy, and it was up to me to diagnose their choice. Crush, what a responsibility!

When the car honked up, Tom exclaimed:

"What's the hand bag for? Are you taking a trip afterward?"

"No," I replied. "These are just a few diagnosing tools—cold chisel and hammer, flashlight, drill, compass saw."

"Oh, say," he laughed, "we're not going to burglarize a house, or build one, either."

"No, and we won't wreck your future home," I assured him. "I wouldn't hurt that house for anything. Of course it oughtn't to be so frail that—"

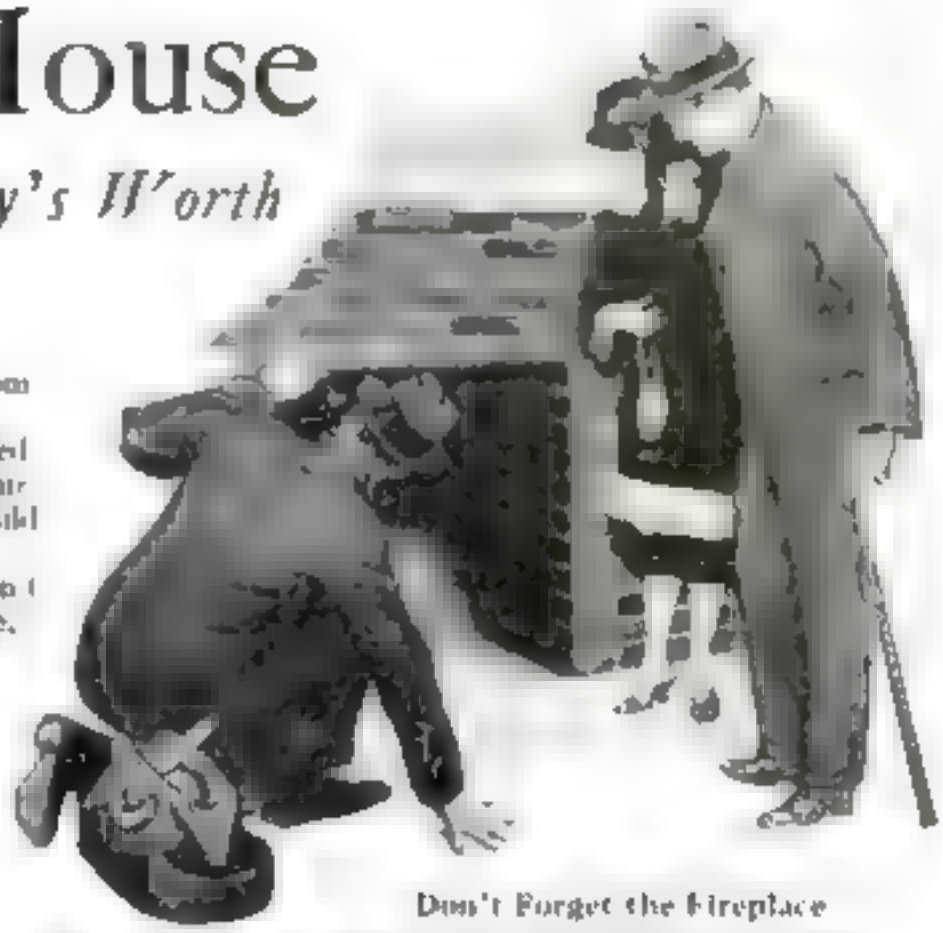
"Oh, I do hope you'll like it and say it's good," twinkled Margery. "It is so pretty in front, with two cute pillars, and the living-room is papered beautifully. The whole style is near-colonial, I think the agent said."

Soon we arrived at the house, which was brand-new, spick and span, as tidy and attractive as Noah's ark on a Christmas tree. It was built by a speculator to sell—but I don't believe in passing harsh judgments in advance. So I agreed with Margery that the place looked charming, and said we would temper justice with mercy in probing the interior of the dwelling. She went in first to gloat over her living-room. We descended to the cellar, where I unpacked my tools and began to attack the concrete foundation wall in various places with cold chisel and hammer.

"We might as well know," I explained to Tom, "whether this foundation is real concrete. Sometimes cinders are used in a cheap job or the material has been frozen, so you can almost poke a finger through the wall. Now this acts solid enough. It's hard and ought to be genuine. It's watertight too, at least for this well drained location. If the site were wet and we saw signs of moisture, we would have to consider the need of hot-tarring the walls outside and also plastering them inside with a rich 1 to 2 Portland cement mortar. Besides that, tile drains along the walls might be required. So far, you're in luck."

Tom, poking around a far corner with the flashlight, discovered a damp spot on the wall about a foot square. He taunted me on this. I told him that one defect in the whole cellar proved my point; you could fix it forever with a cent's worth of cement and five minutes' labor. This was the wet season and the wall had one damp spot. Forget it!

"How do you like the chimney foundation?" Tom asked.



Don't Forget the Fireplace

No wood should be nearer the chimney than the width of two bricks laid flat, nor less than four inches from the fireplace base to be safe

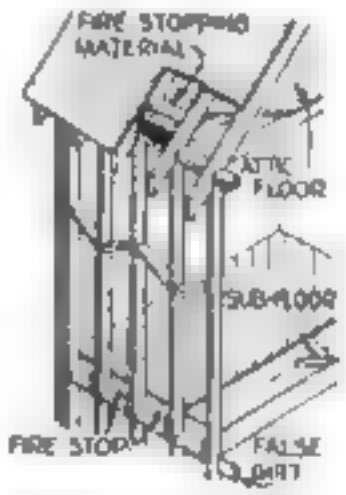
"It looks like an honest piece of brickwork. Would be better if that arch between the two halves were higher to give head room and light. I'm glad to see an ashpit for the furnace flue and another one for the open fireplace. Now I'm going to pull out this furnace pipe and feel inside to know whether there is a flue lining. Later we'll look down the chimney from the roof to see whether the lining runs all the way.

Unsafe chimneys cause a vast number of house fires. Sometimes chimneys are built on wooden props. Then wooden beams are built right into them. Above the fireplace, no wood should be closer to the chimney than the width of two bricks laid flat, plus flue lining. It is also a safe rule to keep woodwork four inches from the base of a fireplace. That space should be filled with unburnable material like mortar rubbish, supported on a metal strip nailed to a beam. I hope there is no wooden mantel upstairs, or if there is one, that it is at least a foot above the fireplace opening."

Do you approve of this made-up girder?" asked Tom.

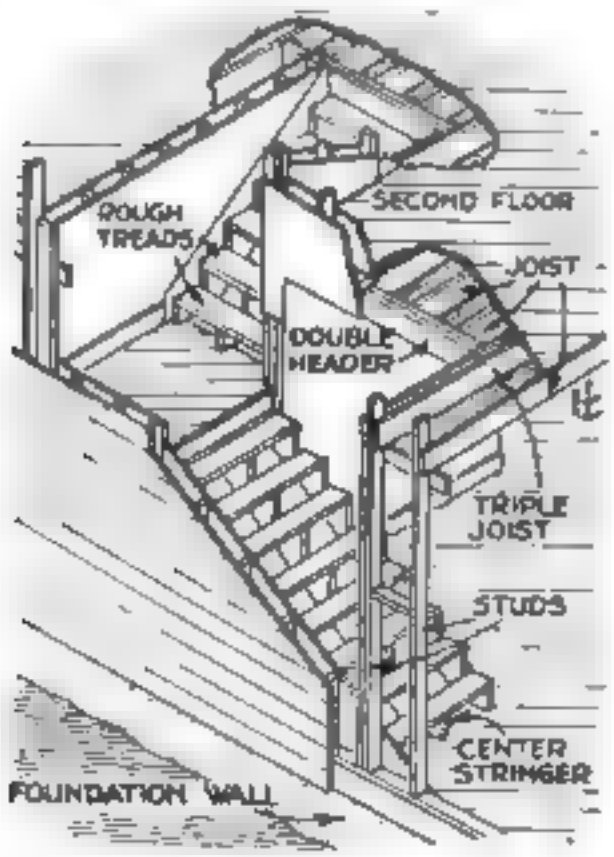
"It looks all right. Three two-by-tens spiked together, with joints coming over the columns, are strong enough for a small house. These two cast-iron columns, presumably filled with cement, are a good proposition too.

"Now I'll put my two-foot rule on these floor joists. You see they are spaced on sixteen-inch centers. That is correct. So is the bridging, that line of X braces between joists every eight feet. Unfor-



Lessens Fire Hazard

Fireproof material placed at top of beams seals air pockets and cuts fire hazard to the minimum



Best Type of Staircase

Staircases built with double treads do not squeak and of course they have more than usual strength

tunately Mr Speculator couldn't keep up the pace. He had to skimp a bit on the joists themselves, using two-by-eights instead of two-by-tens. Before I condemn him utterly, I'll glance over this government table of proper sizes of joists for given spans. Ah! Our joists are southern yellow pine. I know that by the mill stamp, if not otherwise. For this material, with size and spacing as we have it, the table permits a span of thirteen feet, eight inches. Now let's measure the actual span. Tom, this is rich! Our speculative friend has saved his hide by a margin of one inch!"

"If that's the way he's worked all through the house, I don't want to buy," said my young friend.

"I would suspend judgment," I replied, "for the present, anyhow. Look at those wide, stout stairs leading to the kitchen."

Tom chinned himself to the top of the cellar wall and gave a yell.

"The blankety house has no sill," he announced.

"That sounds bad," I agreed, "and in the old days it would have been thought a fatal defect. But now it is recognized as good practice to omit the sill and let the floor joist ends rest on the foundation wall. With this method the joist ends butt against heavy planking that is on edge along the outer side of the foundation, which makes a so-called box sill. Where do the wall studs rest? On top of the joists, above the subfloor boards.

"I'LL TELL you the object of this system. Wooden houses shrink and settle. If they do so unevenly, plaster cracks and doors stick, but uniform settlement makes no trouble. Now, wood shrinks across the grain, not lengthwise of the grain. It follows that all the shrinkable horizontal timbers of a house should be equalized in height or depth, and not mated, so to speak, with the unshrinkable vertical studs. If the wall studs were on a sill, the house would eventually settle an inch or two in the center. But the studs being everywhere seated on top of the joists, the shrinkage of the latter gives us the benefit of uniformity. Incidentally the box sill planking keeps out cold and vermin at the foundation."

"I think you must be a friend of the speculator," laughed Tom.

"Wait. I'll hand him some brickbats now—for not sealing the space between posts on the foundation wall. At each story the spaces between studs should be sealed with two-by-four pieces. This keeps fire from spreading too quickly and also discourages vermin.

"Furthermore, the outside wall studs should be diagonally braced two ways with inserted two-by-fours, the corner studs doubled, and each corner braced on its two sides. Still, the sheathing boards have been put on diagonally. That braces the whole house and keeps it from sagging. When you sheathe this way, and put on good building paper, and cover with first-quality shingles or siding of white pine, cedar, cypress or another enduring wood, you have a real house wall."

"Does this steam heating plant seem all right to you?" asked Tom.

Simple Test for Foundation

Small holes in the cellar wall will show whether the masonry is solid or whether it is loosely filled

"Yes, it looks so, being a standard make with asbestos molded on the boiler, and only one pipe over there lacking asbestos cover, which you can apply yourself.

"Come out of that cellar, you men," sang out Margery at the head of the stairs. "I'm sure it's a lot more interesting and worth-while up here.

I hope you haven't found anything really wrong with this house," said Margery to me, anxiously. "I'm just crazy about it. Now don't you think this is a nice, bright, cozy, little kitchen?"

"It seems so," I agreed, "with porcelain sink, nickel fixtures and ditto trap, built-in cupboard, and a noble cookstove for either coal or gas."

"Take a look at the bathroom," suggested Tom, "and tell us whether the plumbing system looks O. K."

It does, but you know there is a lot of hidden work in plumbing, and we must hope that the unseen is equal to the seen. Of course there is a plumbing code here and an inspector who is supposed to supervise jobs. We saw downspouts that the main waste line is cast iron caulked with lead, as it should be. Every fixture has its proper trap. There's a faucet that has been leaking consumedly, but probably all it needs is a new fibre washer. People fuss about a thing like that, which really amounts to nothing, while they overlook important defects.

"AS WE came into the house by the cellar, I noticed one vent pipe for the whole plumbing system sticking above the back roof. This would make an old-time plumber gnash his teeth. He'd say that every fixture needs a separate vent that was the rule from the time of Noah. But a government committee has lately decided that Noah didn't know it all and that one four-inch vent, the same size as the main waste line, is enough for a small system."

"What is a vent for, anyway?"

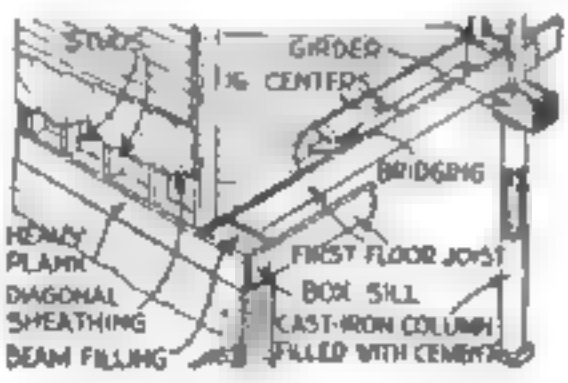
"It's principally to give an outdoor outlet to sewer gas and to have water flow freely in the pipes without emptying the traps by suction, which would permit gas to enter the house."

Margery hastened our progress to the living-room, and we spent some time admiring purely decorative features, such as wallpaper, white enamel trim, a fireplace of speckled face brick and fancy carved balustrade for the stairs leading to the floor above. But all this reminded me of the cabinet work and upholstery of a car. My concern was with the structural makeup, underlying materials and essential machinery.

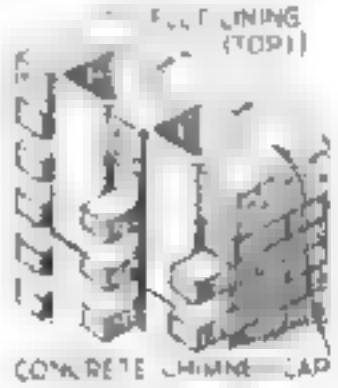
Well, we proved up the fireplace as to flue lining, narrow throat, and expanded smoke chamber, as well as the heat-reflecting forward slope below. And we made a small test fire with scraps of wood. The steam radiators were approved as being cast iron and not steel which is cheaper and less enduring. Apparently there had been a test of the steam plant and one of the radiator coils had leaked slightly. I assured my young friends that this was not a serious matter at worst a new coil could be substituted for the defective one.

"How does the trim in this room strike you?" asked Tom.

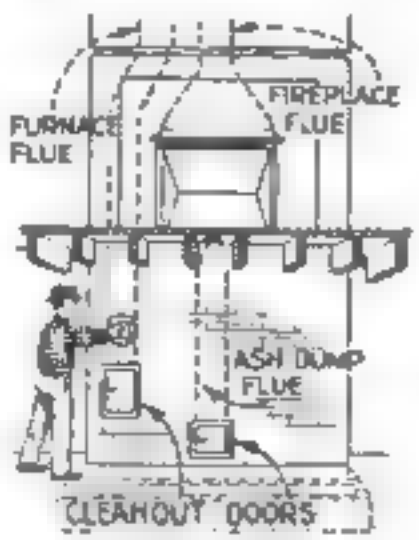
"It is some kind of soft wood (Continued on page 140)



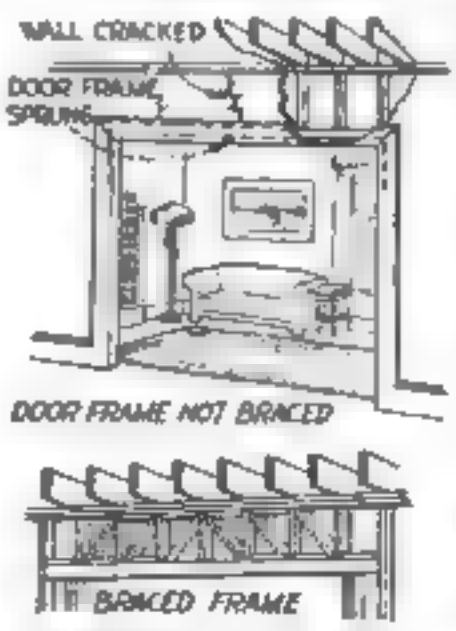
This sketch shows the way the frame should rest on the foundation in order to avoid unequal settlement



To prevent bricks from falling, a concrete cap should top the chimney



Separate cleanouts should be provided at the bottom of the furnace and fireplace flues, to prevent clogging the chimney



Cracks in plaster over wide openings are due to lack of trusses, which give rigidity

Six Tests

To Help You Get a Line on Yourself

Fascinating New Ways to Classify Your Abilities

WHEN the time arrived for your father and grandfather to take their first jobs, it is likely that they fell into the ones nearest them and stuck to them even if they disliked them. In those days, once started it was hard to change.

Modern psychologists, though have made it possible for you to avoid this discouraging trial-and-error method. They have devised ways for you to test the powers of your own mind, and measure your fitness for various callings so that you can concentrate your energy on something in which you are likely to succeed.

On these pages, Dr. Albert Johanson, of the Department of Psychology, Columbia University, offers six new ways to measure your abilities by illuminating tests worked out by specialists in vocational guidance.

Last month Dr Johanson enabled you to measure your coordination of mind and muscles, your power of concentration, the elasticity of your mind, your adaptability and your talent for mathematics.

The tests this month will tell you new and surprising things about yourself when you compare your results with the solutions which appear on page 135.

Have you a good photographic memory? When you see something, is it so impressed on your mind that you can recall it readily later? The code test on this page will tell you this. If you score high here you'd probably make good on a job where you had to remember people's faces. This type of memory is extremely valuable. See what your rating is.

Perhaps you have a logical brain and would make a quick-thinking lawyer, one who can perceive instantly what is wrong in a line of reasoning and why. Straightening out the mixed sentences at the bottom of the page will tell just how clever you are in this respect.

Your leanings may be more toward art. Can you identify forms and their slight differences so as to depict them accurately? The test below will help you decide.

ON THE following page there is a word naming test that determines whether you think as rapidly as the average man. Is your vocabulary limited so that you have to hunt for the word you want to use? Perhaps you have a wide range of words at your command, which flow freely. The test will tell you.

To be a good writer or speaker, you not only must have a wide vocabulary but you must know the exact meanings of words. To try out your own language ability, Dr. Johanson gives you a special test in filling in sentences.

If your forte is figures rather than words, you may shine in the test to be found at the top of the next page.

Have You a Photographic Mind?

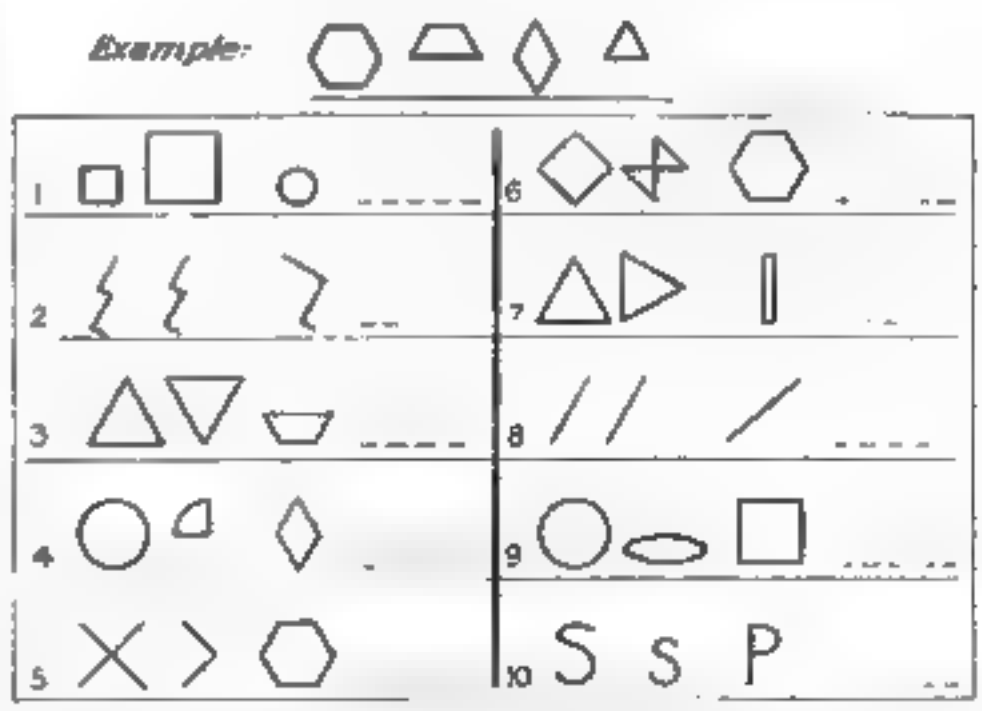
THE four arrangements of lines, dots and letters above form a complete code, as illustrated in the example. In representing a letter, simply draw the lines bordering that letter, including also a dot if the code calls for one. Study the code for five minutes, then cover it up, note the time, and write the words, "come quickly," in code. See how long it takes you. You are not permitted to reproduce the code on paper and copy the letters from reproduction. When you have finished all the tests, turn to the solutions on page 135

Measure Your Mental Agility

THE words in each sentence below are in mixed order, but if you are alert you can catch the sense of the sentence. Mark after each whether the meaning of the sentence is true or false. Do this by underlining the word "true," or the word "false." Allow yourself three minutes. The solution appears on page 135

Sample—see are with to eyes. . . .	True	False
1. day it snow does every not .	True	False
2. and eat good lime sand to are	True	False
3. are clothes all made cotton of.	True	False
4. horses automobile an are than slower	True	False
5. iron paper made of is filings .	True	False
6. pole north equator mile one from is the the	True	False
7. always is not a a stenographer bookkeeper	True	False
8. sails is steamboat usually by propelled a	True	False
9. ninety canal ago built Panama years was the	True	False
10. as sheets are napkins used never	True	False
11. usually judge can we action man his by a.	True	False
12. happiness source of always a crime is	True	False
13. never man the show the deeds .	True	False
14. forget trifling friends grievances never	True	False
15. seen can the moon nights not be some	True	False

Are You Able to Analyze Forms?



IN EACH of these ten problems you are to draw a figure in the space above the dotted line. This fourth figure, in each case, should bear the same relationship to the third that the second bears to the first. Thus, in the example, just as the second figure is the upper half of the first, so the fourth is the upper half of the third. Work four minutes. For solutions, see page 135.

See How Fast and How Correctly You Can Add Figures

Add 17 to each number below. Write your answer next to the number. Keep track of the time it takes you. When through, check your answer for errors, adding five seconds for each error to your total time. *Ratings on page 135.*

64	61	52	44	32	47	70	51	60	73
49	71	70	36	59	43	41	69	71	38
62	33	26	73	31	35	62	29	48	63
57	38	34	63	60	64	25	74	53	58
68	28	45	47	48	49	40	50	61	32
74	65	72	43	54	67	57	30	36	59
53	41	35	66	46	28	26	56	42	52
67	50	51	69	55	46	58	44	34	45
25	42	30	37	27	55	66	31	39	72
40	58	56	39	29	65	27	37	33	54

How Easily Can You Handle Words?

ON EACH line write the words that make the best meaning. Insert only one word in each blank. Do as much of this test as you can in four minutes. You will find the solutions on page 135.

1. The sky _____ blue.
2. We are going _____ school.
3. The kind lady _____ the poor man a dollar.
4. The _____ plays _____ her dolls all day.
5. Time _____ often more valuable _____ money.
6. Boys and _____ soon become _____ and women.
7. The poor baby _____ as if it were _____ sick.
8. The _____ rises _____ the morning and _____ at night.
9. It is good to hear _____ voice _____ _____ friend.
10. She _____ if she will.
11. The poor little _____ has _____ nothing to _____; he is hungry.
12. The boy who _____ hard _____ do well.
13. Men _____ more _____ to do heavy work than women.
14. It is a _____ task to be kind to every begger _____ for money.
15. Worry _____ never improved a situation but has _____ made conditions _____.
16. A home is _____ merely a place _____ one _____ live comfortably.
17. It is very _____ to become _____ acquainted _____ persons who _____ timid.
18. To _____ many things _____ ever finishing any of them _____ a _____ habit.
19. One's real _____ appears _____ often in his _____ than in his speech.
20. When one feels drowsy and _____ it _____ happens that he is _____ to fix his attention very successfully _____ anything.
21. The knowledge of _____ use fire is _____ of _____ important things known by _____ but unknown _____ animals.
22. _____ that are _____ to one by an _____ friend should be pardoned _____ readily than injuries done by one _____ is not angry.
23. To _____ friends is always _____ the _____ it takes.
24. One ought to _____ great care to _____ the right _____ of habits, for one who _____ bad habits _____ it _____ to get away from them.

Here's a Way to Measure Your Vocabulary

WRITE down as many words as you can in three minutes. Use any words that come into your mind, and write them in the form that takes the least time.

Do you think as rapidly as the average man? Do you find that the same words keep coming into your mind? Is your vocabulary limited—do you have to hunt for words to use? Or have you a wide range of words at your command? Do your words flow freely?

This test will answer these questions for you, and tell you whether you need to increase your store of language.

To know how you compare with others, turn to page 135.

IF YOU *have enjoyed this interesting series of tests and have found that they have stimulated and quickened your mind, you will look forward to a story of the world's greatest puzzle expert, in next month's issue of* POPULAR SCIENCE MONTHLY.

In more than forty years he has devised thousands of puzzles to tantalize and challenge people's thinking abilities. Out of these he has chosen what he considers his triumphs, the very best puzzles he has made. These will be given you, along with the fascinating story. Get ready to work your brain overtime.

Secrets of Lifting Weights

How Experts Carry Trunks, Furniture, and Other Heavy Objects with a Minimum of Strain by Distributing the Load

To carry a suitcase with greater ease bend the elbow to take part of pull off forearm, upper arm sharing it

The Correct Way to Lift Heavy Weights

In lifting big pieces of furniture like the dresser shown above, or a piano, get as close as possible and make thigh muscles do most of work

A trunk may be carried readily by tipping it to rest on the thigh and grasping it at the top as above

AN UNDERSIZED, puny expressman comes trotting along with a trunk three times his own weight on his back. You are amazed at the great strength of such a slight fellow. Yet it is not a question of strength entirely. He has learned by long experience how to lift and carry weights.

Like the Chinese coolie who carries seemingly impossible loads by dividing them in two and attaching them to both ends of a long pole so that the weight rests on the shoulders, he knows how to distribute the weight to make it easier to carry.

Dr. J. F. Williams, professor of physical training at Columbia University, New York, who for many years has studied this interesting subject, gives some secrets of lifting heavy objects.

"The strongest muscles in the body," he explains, "are the heavy thigh muscles. These should be used in lifting whenever possible. The shoulders, too, can be used. Don't stoop and expect your arm muscles, supported by the back, to lift a heavy weight. The weight at the end of the arms is at the end of a long lever with fulcrum at the pelvis, and the mechanical disadvantage is terrific.

"To pick up a weight, squat with back kept straight. Grasp the object, then straighten up, and the whole work of lifting will be done by the legs.

"Always keep a weight as close to the body as possible. Whenever it is away from the body there is extra work to do. When you can, get the weight on top of your own. The Indian squaw who carries her baby on her back, unlike our own American mothers, has the right idea.

"Another good idea is to follow the Oriental's plan of balancing weights when you can. If you are planning to take a long trip, for example, buy two suitcases instead of one and distribute your load. You will be able to carry your baggage with less fatigue than if you have only one."

The professional trunk mover never strains his back because he doesn't use it. The weight is made to rest on his thigh muscles, the strongest in the body. If you have a trunk to move, roll it around on its corners. If this might cause damage to the floors, then lift it by the use of the legs.

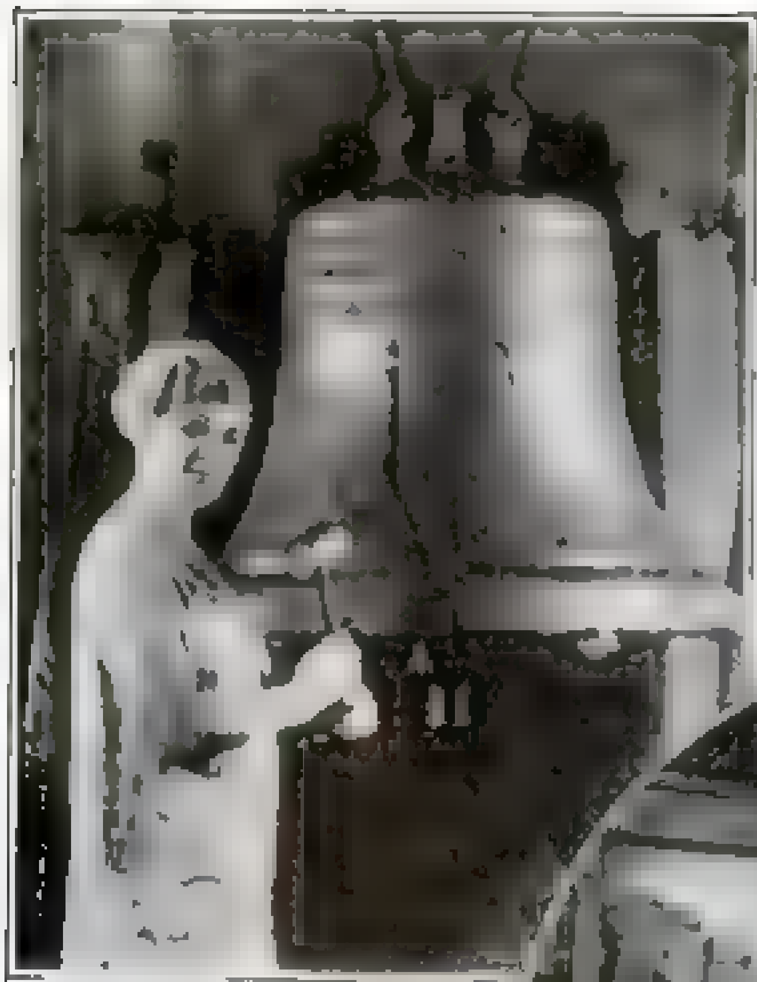
The secrets of lifting heavy weights might be reduced to the following principles:

1. Keep weight close to the body.
2. Make use of the leg muscles whenever possible.
3. Divide and balance the weight.
4. Try to get the weight on top of your own.

Try out the suggestions on this page. Remember that a slight mistake in lifting may cause injury to your whole body.

The Right and the Wrong Way to Raise a Barrel of Ashes

The correct method, illustrated at the left, is to get down close to the barrel by bending the knees, grasp the handles, and then straighten up. Trying to lift it with the back and arms while keeping the knees straight is likely to cause a muscular strain

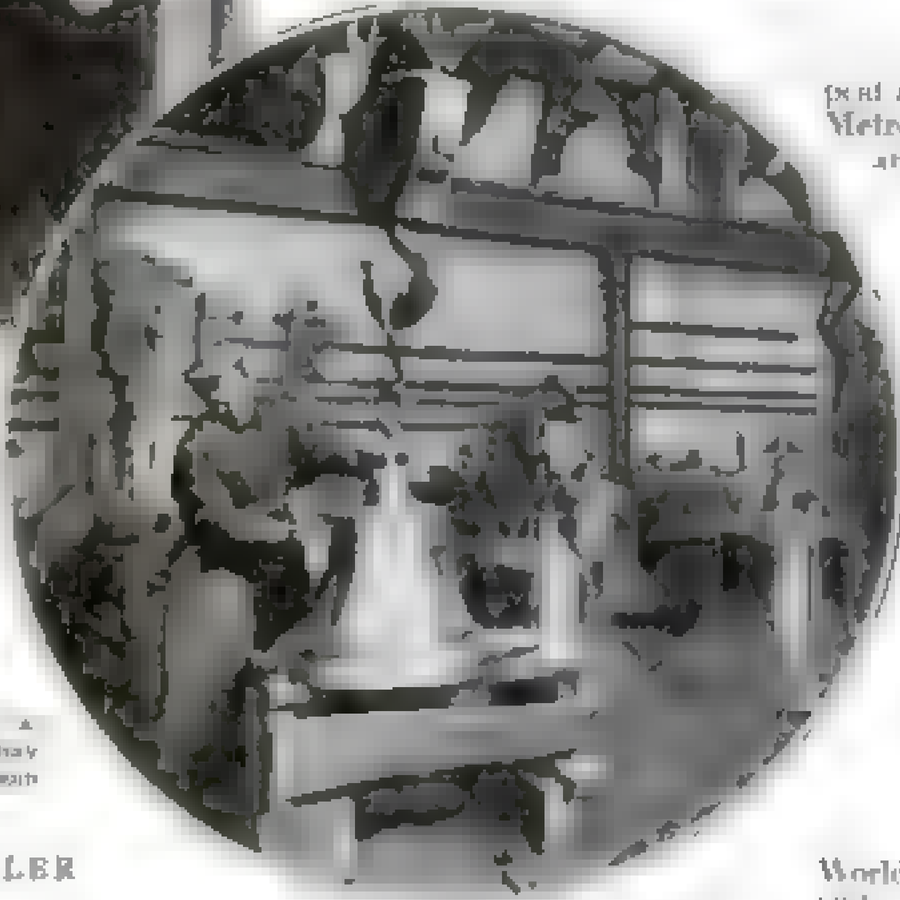


Liberty Bell's Radio Debut

Thousands of us heard the famous Liberty Bell for the first time over our radios at the birth of 1926. Our picture shows Mrs. W. Freeland Kendrick, wife of Philadelphia's mayor, about to strike the bell on that occasion [illegible] in the year

The Magic of Chimes Grips America

How modern alchemy turns fire, water, metal, and sand into the marvelous music of singing bells



Hold Makers' Secrets

The sweeps designed [illegible] [illegible] [illegible] the [illegible] [illegible] bell [illegible] be seen on the wall of [illegible] [illegible] room

Courtesy Meneely Bell Co.

By Edgar C. Wheeler

I HAVE just witnessed a strange wonder of twentieth century alchemy. I have seen men take the commonest substances of the earth—fire, water, metal, and sand—and transform them, by the magic of science, into marvelous music, the music rung from chimes of singing bells!

From a roaring cauldron I have seen streams of boiling metal flow into great trumpet-shaped forms of intricate curve and line which, trembling into life at a touch, give full-throated voice to human joys and sorrows. And in this wonder I have seen the hand of man at one of the finest examples of craftsmanship.

My visit to this marvelous birthplace of bells was a result of the wide interest manifested in America recently in the music of church bells, chimes, and carillons. When the famous old Liberty Bell rang in the New Year, giving from its cracked sides the first sounds it has ever uttered over the radio, its voice seemed to signalize a change in the New World's musical fancy.

For centuries this ancient form of music has been flung over the countryside from the "singing towers" of Flanders and Holland and from the parish belfries of England. Chiming notes, year upon year, have voiced the vital events of existence, ringing out the hours of work and rest, singing of birth, tolling for death, sounding alarms, celebrating freedom and victory, and summoning to devotions.

And then in recent months, chimes and carillons have been placed in many American bell towers. You have heard, perhaps, on your radio, strange vibrating melodies from the great carillon of fifty-three bells brought from England a few months ago to the Park Avenue Baptist Church in New York City. Running the full chromatic scale of notes, these bells can play the works of the great masters.

Another great carillon, duplicating the New York bells, is being erected in Ottawa, Canada. Princeton University is to have another.

Others are ringing at Morristown and Plainfield, N. J., Gloucester, Andover and Cohasset, Mass., Cranbrook and Detroit, Mich., and Birmingham, Ala.

Perhaps you also have listened to the new American-made chime of twenty-two bells, whose golden notes first rang out from Grace Church, New York City, last Easter; or the first radio chime of twelve bells whose voices now echo almost to the ends of the earth from a nine-story bell tower at broadcasting station WSAI in Cincinnati.

Not quite so new, but equally famous, are the four mammoth bells—the loftiest in the world—which peal away the hours 600 feet high in the Metropolitan Tower in New York, and are heard by mariners nearly thirty miles out at sea. And now these bells, the largest of which weighs nearly three tons, have been duplicated for buildings in Chicago and in Philadelphia.

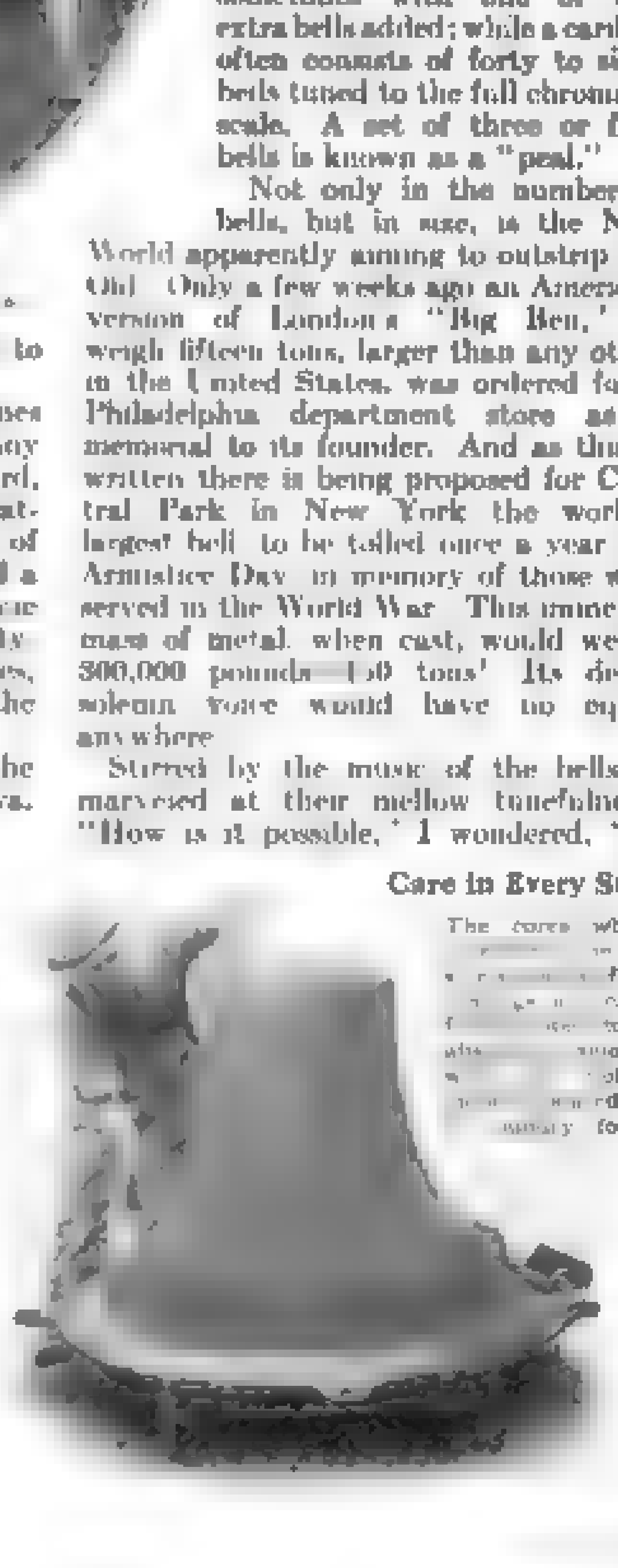
The word "carillon" is strange to many of us, but it is simply a French word meaning "chime." In America, however, a chime generally is understood to consist of eight bells, tuned to the eight full tones of the octave, sometimes with one or two extra bells added; while a carillon often consists of forty to sixty bells tuned to the full chromatic scale. A set of three or four bells is known as a "peal."

Not only in the number of bells, but in size, is the New World apparently aiming to outstep the Old. Only a few weeks ago an American version of London's "Big Ben," to weigh fifteen tons, larger than any other in the United States, was ordered for a Philadelphia department store as a memorial to its founder. And as this is written there is being proposed for Central Park in New York the world's largest bell, to be tolled once a year on Armistice Day in memory of those who served in the World War. This immense mass of metal, when cast, would weigh 300,000 pounds—150 tons! Its deep, solemn voice would have no equal anywhere.

Stirred by the music of the bells, I marveled at their mellow tunefulness. "How is it possible," I wondered, "to

Care in Every Step

The care which [illegible] in [illegible] of the [illegible] care[illegible] to be [illegible] smooth [illegible] often [illegible] into [illegible] forms



shape tons of metal into a musical instrument so accurate in design that its voice will sing in harmony with twenty or fifty others?"

Is it true, as we have been told, that the present revival of bell ringing comes from the rediscovery of lost secrets by which bell founders of three hundred and more years ago created the famous carillons of Ghent, of Bruges, and of Malines? Do the modern chimes we hear bespeak the resurrection of a forgotten art of bell tuning?

A search for answers to these questions led me, a few days ago, to a bell foundry in the city of Troy, N. Y. There I learned that, as a matter of fact, the secret of bell making never has been lost. Rather, it has been known only to a few who have passed its mysteries along from father to son. There I learned, too, that the art of bell tuning, instead of being rediscovered, has been advanced, through scientific methods, to a degree of accuracy never before accomplished.

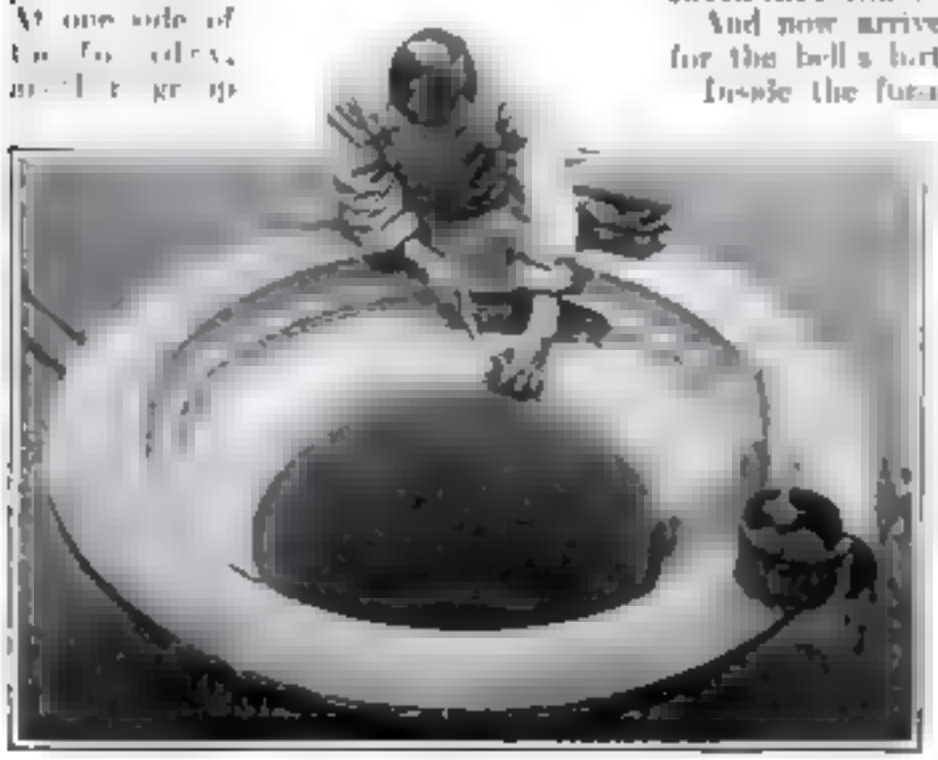
IN THAT bell foundry I met a gray-haired, pleasant-mannered business man and manufacturer—not at all the man of mystery you might imagine. For thirty-five years this man, Chester Meneely by name, has been making and tuning bells, as did his father, his grandfather, his great-grandfather and his great-great-grandfather before him.

"You want to see how the bells are made?" he said. "Come along and I'll show you. We can make bells with more beautiful tones than ever before," he added, as we passed into the foundry. "Because we have finer metals to make them with.

"There's a belief that silver bells are sweetest. That's a mistaken idea. The most perfect bells are made of just two metals—seventy-eight percent copper and twenty-two percent tin. Here is some of the tin now; from the biggest tin mines in the world, in Malacca on the southeastern tip of Asia."

As he spoke we came upon a group of workmen who were moving a small truck loaded with 100-pound pigs of golden-yellow tin toward a great brick furnace large enough to hold 30,000 pounds of metal.

At one side of the foundry, a group of men was putting a mixture of damp sand, clay, and plaster of Paris, building up molds in which were to be cast a new chime of ten bells for a church in St. Augustine, Fla. Above our heads was a great steel traveling crane running on tracks between the furnace and the molds.



Artists Prepare Outer Mold

All ornamental lines and inscriptions for a new bell are carved into the inner surface of the outside mold by skilful engravers

And now arrives the appointed time for the bell's birth.

Inside the furnace, since early morning, flames have been baking away at 15,000 pounds of Michigan copper. Now, after six hours, the solid pigs of metal are melted into a pool of white-hot liquid. The time for the tin comes. Workmen place the heavy yellow bars on the end of a long plank which they thrust through a door into the furnace. For a brief instant the tin blocks balance just above the molten sea. The plank tips and the blocks tumble headlong into the seething cauldron. Puff! They are gone! They vanish, like drops of water on a red-hot stove.

Meanwhile, in the woods at the outskirts of the city, a wood chopper has felled a score of green saplings and has returned with them to the foundry. Again a furnace door opens, and this time the ends of half a dozen of the saplings are thrust into the heart of the molten liquid. And then, as wet sap and fire meet, a most amazing thing happens.

IN A FLASH the placid sea is aroused into a boiling inferno of dancing, leaping metal, while from the depths of the cauldron there issues a tremendous unearthly roar.

Thus the bell maker's magic wands mix the metallic brew from which he fashions one of the oldest forms of music on earth. Little wonder that the casting of a bell so often is attended by solemn ceremony and deep emotion.

"I remember once," Meneely recalled, "a father and mother came here for the casting of a bell which was to be their gift as a memorial to their small son who had been drowned. When the mixing of the metal was at its height, they threw into the boiling mass a small watch, a silver coin and a number of trinkets they had found in the lad's pockets.

"At other time, during the casting of a set of bells for Mount Holyoke College, a group of students attended. Above the din of the dancing metal they raised their voices in college songs.

"Sometimes we are asked to recast the metal of an old bell to form a new one. Because of modern methods of refining copper, rarely is one of these old bells equal in quality to the metal we use today; and so we advise against it. Instead, we take a small piece of the old bell and melt it with the new, thus perpetuating in a new form a thing to which memories have been linked."

Chimes Popular with Radio Fans

Radio enables people throughout the country to enjoy the 53 bell chime of the Park Avenue Baptist Church, New York City. This carillon, the largest in the world, is a memorial of John D. Rockefeller, Jr., to his mother. At top, broadcasting director at mixing the microphone; below, Anton Brees, carillonneur, at the keyboard

AT LAST, when the roaring metal has boiled and mixed sufficiently—a fact determined by an instrument for reading high temperatures, known as a pyrometer—the white-hot liquid is drawn from the furnace through a spout and into a huge ladle. This, in turn, is carried by the traveling crane, and from it the metal is poured into the bell molds.

It is in the shaping of these molds, I found, that the real secret of the bell maker's wonderful craftsmanship lies. In the first place, a slightest variation in the girth of a bell, or the weight of the metal in it, will change by that much the tone at which the bell is pitched in the musical scale. And second, the quality of a bell's tone—its rounded mellowness or its clanging harshness—depends not only on the purity of its metal, but on the delicate curves of its form. In this respect the fashioning of a great bell may be-

(Continued on page 144)

Improving on Nature

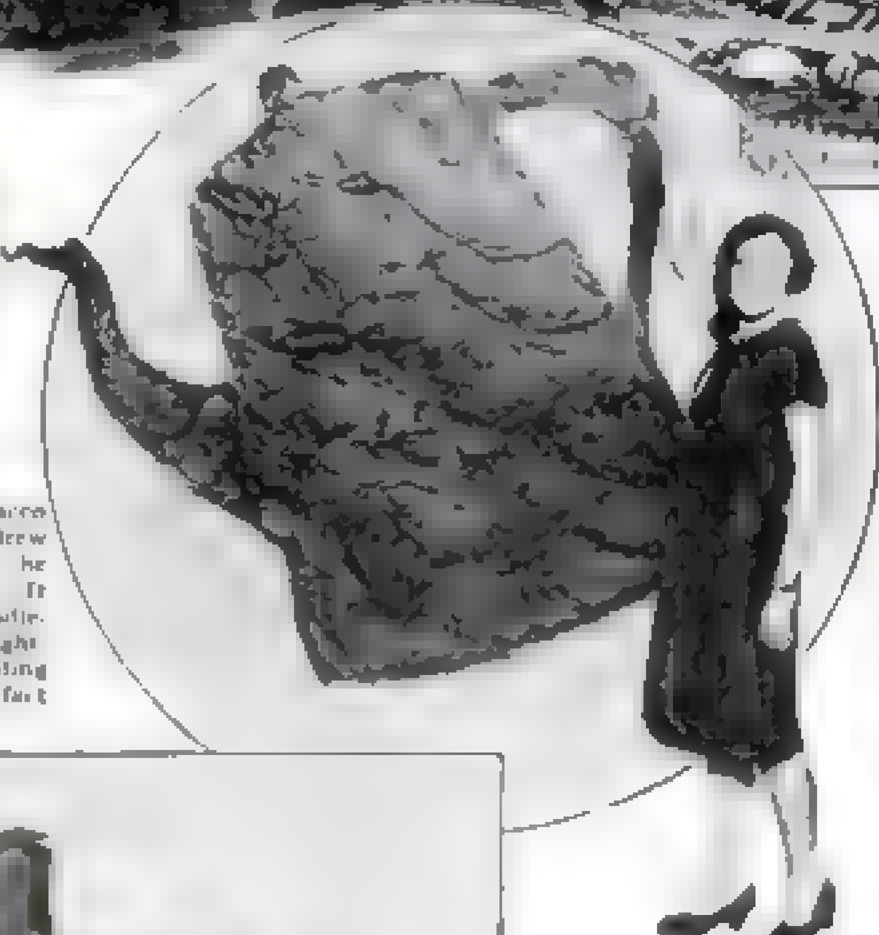
Sculpture in Flower and Leaf

An Elephant of Roses

Blanketed in leaves and flowers and built on a float, this huge elephant carried off third prize at the annual Tournament of Roses held at Pasadena, Calif., in which every prominent California city was represented

Flower Clock That Goes

A large clock made entirely of flowers is one of the chief objects of interest in the famous tourist center of Interlaken, Switzerland. The flower bed was laid on the face of a real clock, and even the hands are wholly covered with flowers. The clock, which many visitors admire, despite its covering keeps fairly good time



Smoking Coffee Pot

This huge coffee pot made of tobacco leaves grown in Coffee County, Ga., drew large crowds when it was shown at the Southeastern Fair held at Atlanta. It looks ponderous and too heavy to handle. But in reality, it is actually quite light. A Georgia miss can be seen here holding it off the ground, to demonstrate that fact

Carves Horse in Hedge

Visitors travel long distances to see the sculptured hedge that surrounds the garden of C. J. Aldham, a quaint old character of Essex, England. Many odd shapes and cut-out designs are features in it. He is shown here at work on his latest masterpiece in the form of a gigantic horse

A "World" of Plants

This green globe is one of the curiosities of Leavenworth, Kan. It is twelve feet across, and consists of a wire netting sphere filled with dirt. Green plants representing the water and brown, the land, are used to map the continents and oceans

Odd Styles in Trees

The imagination of the artist and the skill and patience of the carver have combined to produce this extraordinary landscape effect. It adorns an Iowa farm, and represents years of labor by the owner and caretaker. Some of the trees, as seen, are finished almost with the fineness of sculpture

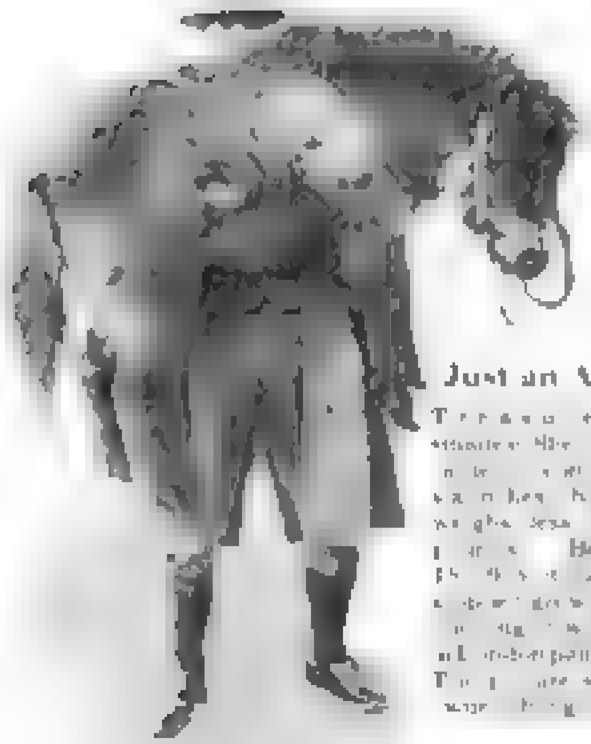
Caging a Python

It took eight husky men to unpack and carry to the cage a 20-foot python recently brought to the London Zoo from Singapore, India. The picture of the reptile [illegible] attendants all the way to the cage gives some idea of its great length

Animals Snapped in New Poses

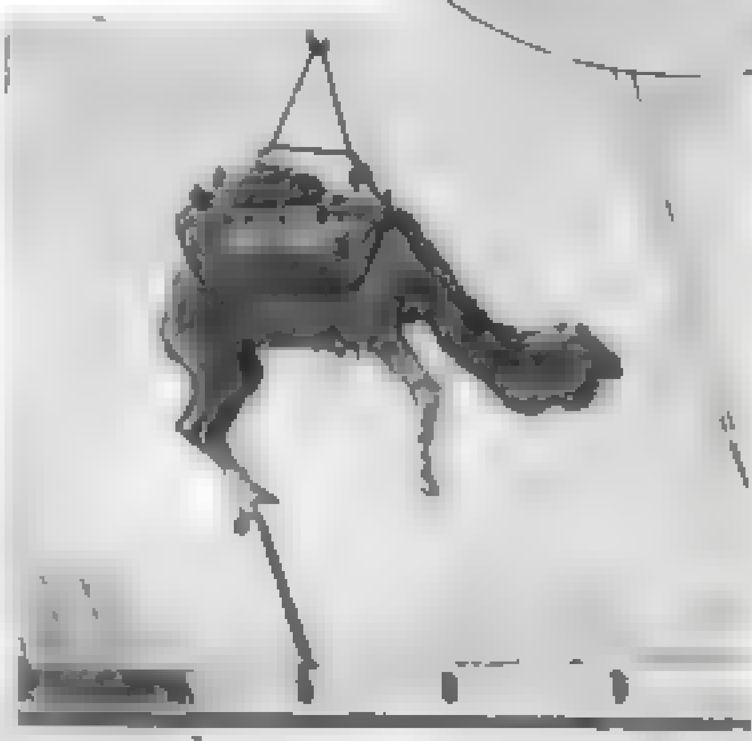
Beautifying Anna

Anna May [illegible] elephant [illegible] Los Angeles [illegible]



Just an Armful

[illegible]

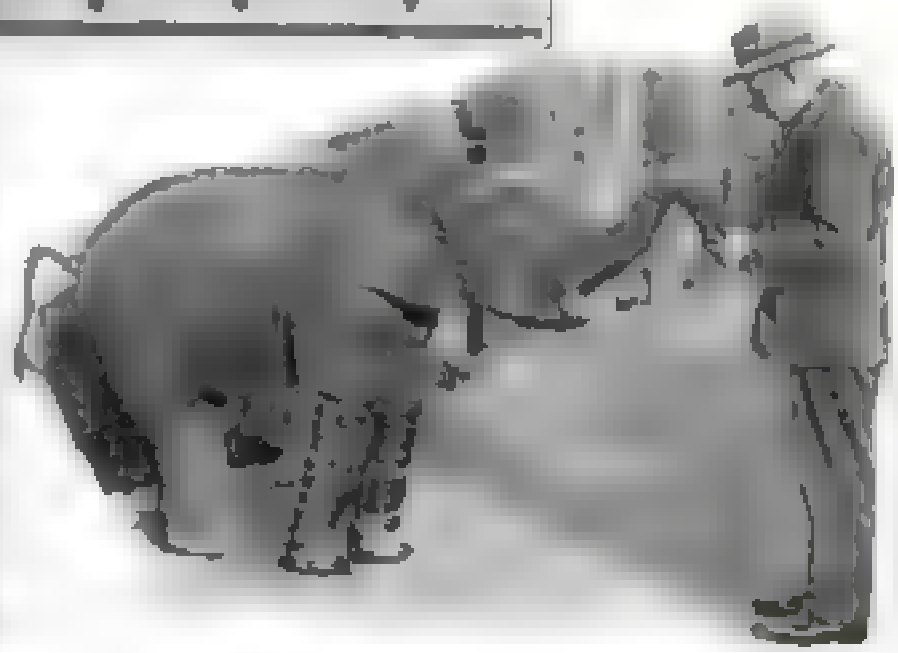


Slinging a Camel

The camel in a sling [illegible] shows the usual method [illegible]

Tiger Leads Score of Keepers a Merry Chase

Minnie, a tigress with a circus near Culver City, Calif., broke her ropes recently and, leaping an eighteen-foot wall, made her escape. It required a score of men to capture her after she had given them a merry chase across the country. She was snapped here, eluding one of her pursuers

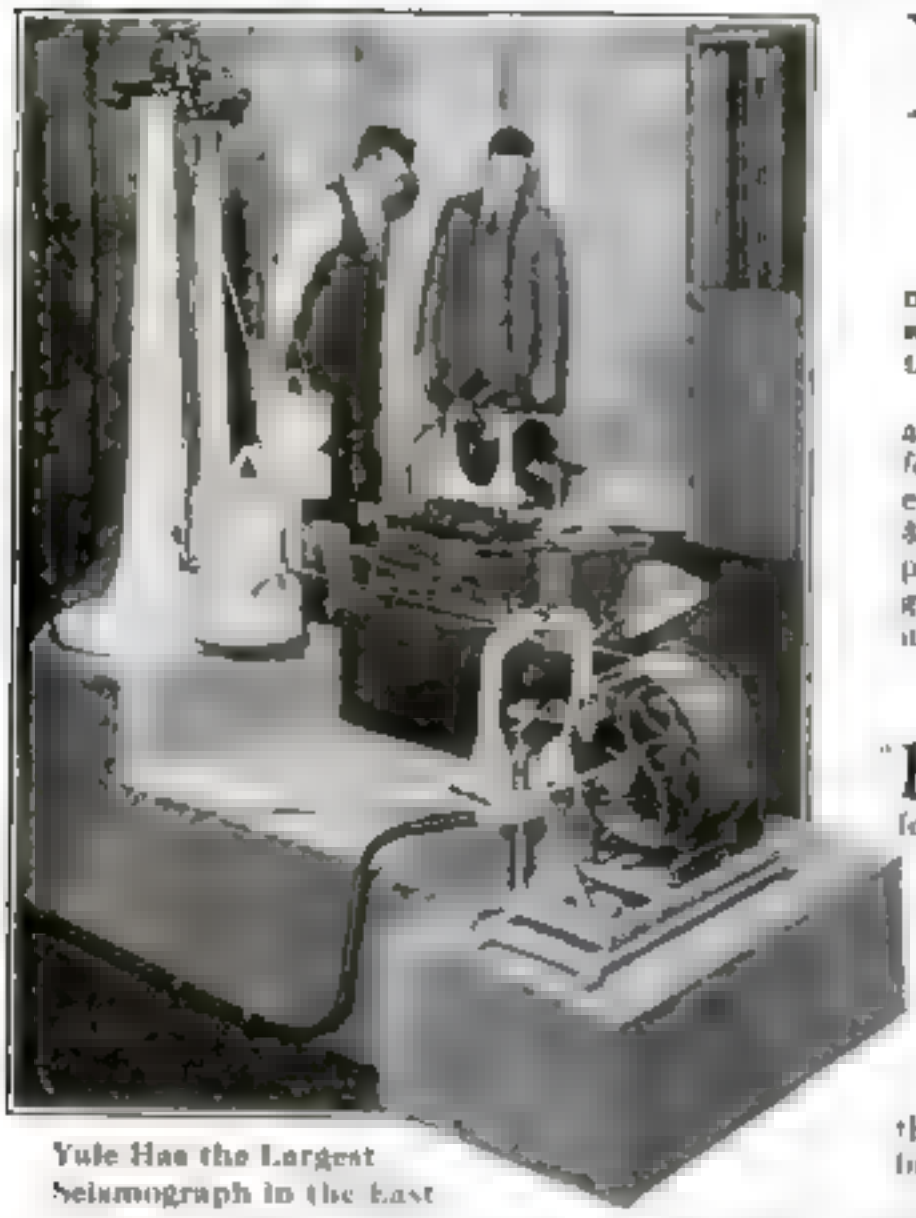


Boots Bolster Pygmy Elephant's Knees

When the keepers of the London Zoo decided the pygmy elephant, Oojah, needed something to brace his knees, they made a plaster of Paris cast, from which they shaped boots of tough leather and steel. The photo shows Oojah to be quite contented with his new knee supports

New Milestones

Recent Findings That Extend



Yale Has the Largest Seismograph in the East

This gigantic machine, used for recording and locating earthquakes and other disturbances below the earth's surface, was recently set up and put in successful operation at New Haven.

On these pages each month are recorded briefly the outstanding scientific discoveries and the most striking inventions that scientists in all parts of the world have contributed to human progress. They will, we are confident, be found useful as well as informative.

New Metal Called Tantalum Replaces Platinum

FOR YEARS chemists have been looking for a metal to replace the costly platinum and its alloy, platinum-iridium, in engineering and research. At last they have found a new material tantalum, which promises a new era in electric work and chemical engineering where great resistance to heat and acids is required.

Tantalum has many "astonishing properties" to recommend it, according to Professor James R. Withrow of Ohio State University, and not the least of these is that it lasts 1,000 times longer than platinum and is twenty times cheaper.

Platinum will be missed as a catalytic agent. The change is necessary, however, because its widespread use in the manufacture of jewelry has made its price prohibitive. But as regards resistance, tantalum is more efficient than platinum and almost as good as platinum-iridium, which is one of the best resistants known. Platinum, for instance, loses by corrosion one gram for every hundred square centimeters in sixty hours, while tantalum loses that amount in 100,000 hours, and platinum-iridium in 125,000 hours.

The life of tantalum is, therefore, 1,600 times greater than that of platinum, and five-sixths as great as platinum-iridium. In other words, 1,600 cathodes of platinum would be consumed while one cathode of tantalum was destroyed.

Cheapness is the final and best recommendation for tantalum in chemical engineering. It costs only $250 a kilogram, while platinum is $4,000 a kilogram, and platinum-iridium, $4,330.

Foretell Plagues

"HEALTH observatories from which forecasts of approaching epidemics will be sent out have been established in the forty-four largest cities of Illinois by Dr. Isaac D. Rawlings, state health director, who adapted the idea from the government weather bureaus.

Each station is supplied with a weekly statement showing the number and location of all reported cases of contagious disease in its territory. With this information, the local health officer can determine the danger and take steps to overcome it.

Epidemics are no longer mysterious outbursts, that spring out of nowhere, and disappear just as suddenly, Dr. Rawlings declares, in announcing the opening of these observatories, they are recurrent disturbances like weather changes, that can be predicted with reasonable accuracy. By the interpretation of carefully gathered statistics and by following the path of the disease he asserts, it is possible to make an almost perfect forecast, which is of the greatest service in aiding preventive medical work.

On this principle, Dr. Herman Bundesen, Chicago health official, has compiled a unique chart, illustrated on the opposite page, by which with the aid of statistics he makes a graphic record of the course and frequency of a disease, and by which he claims he is able to predict with certainty the nearness and intensity of any epidemic.

Reproduces Sounds Better Than Radio

A new instrument right invented by Charles A. Hoxie of the General Electric Company, is said to be superior to the phonograph and even to radio as a sound reproducer. The recording is done by the same process used in the talking film, by which lights and shadows reproduce the sound waves

Ink Blots Test Your Mind

INK blots will tell more about your personality in ten minutes than hours of analysis, according to Professor John J. B. Morgan of Northwestern University.

You can test yourself with a sheet of paper and splashes of red, green or black ink. Ask yourself what you see in them. If they appear merely as blots, you are of the conventional type. If, however, you see in them fantastic and original pictures, then you belong to a creative type above the average.

Psychologists for some time have been using ink blots in this way to study personality, with some excellent results.

How to Count the Stars

IN THE vast universe in which the earth is a mere atom, there are perhaps 60,000,000,000,000,000,000 people. That is what the figures of Professor Frederick H. Seares of the Mt. Wilson Observatory show. For he has counted thirty billion suns in the skies, each of which has at least one attending world. Allowing two billion people the estimated population of the earth for each of the worlds, he arrives at the staggering total above.

Professor Seares recently completed counting the stars in the heavens. This seemingly impossible task he accomplished by mathematical calculations, although he could not see even with the most powerful telescope nearly seven per cent of them. First he divided the sky into squares. Then, taking 139 of these

in Science Progress

the Limits of Our Knowledge

squares, he photographed all the stars included in each space with the great 60-inch reflecting telescope of Mt. Wilson Observatory, which collects 50,000 times as much light as the human eye. A count of the stars in the 139 squares showed [illegible] billion.

These 139 squares, however, represented only the 1-2,500th part of the sky, and included stars only up to the twenty-first magnitude. So he worked out a ratio between the stars of each succeeding magnitude, and by an intricate calculation arrived at the final count of 30,000,000,000,000, a figure whose magnitude is beyond present human comprehension.

Relics from Ancient Carthage

Count de Prorok, noted explorer, is shown here examining [illegible]

Filming New Colored Movies

BLACK and white films may soon be superseded generally by pictures taken, developed and screened in their natural colors. Several large producing companies are already at work upon feature pictures in color.

In making the new pictures, a stronger light is used than in the present drab films and two films of the same scene are taken simultaneously through a single lens. One of these responds only to green light, and is finished in green, while the second, recording only red, is finished in red. The two films are then pasted back to back in exact register, and are ready for exhibition. There is no photographic deposit of silver as in the ordinary black and white picture.

It is hard to believe that red and green can yield such accuracy and variety in shade. Sky tints, leaf, tree trunk or earth shades, hair and flesh tints, and even the effects of black plush and golden satin are faithfully recorded. Pure lemon yellow, cobalt blue and the pure purple shades are not available, however, at least not until some three-color process is perfected.

Seeks Check on Narcissus Bulb Pest

The Department of Agriculture in Washington is engaged in a fight on the deadly narcissus fly. Miss Bruce Broadbent of the Bureau of Entomology is seen (above) studying the infected bulbs of this highly prized flower

The color film costs several times as much as the black and white, but the added expense does not rate high compared with other costs. Unlike the hand-tinted films, introduced years ago, the new films may be reproduced indefinitely, and without [illegible] repetition of the initial cost.

Illness Cause of Temper

A TENDENCY toward violent temper is often a direct aftermath of disease, Dr. George M. Stratton, noted psychologist of the National Research Council, declared recently before the American Psychological Association.

This conclusion Dr. Stratton deduced from a study of the physical and emotional histories of more than 1,000 students, and of twenty classes of diseases, including heart trouble, neurasthenia, and influenza. He found that men who at some time in their lives have had a serious illness appear to be abnormal, and are more subject to intense emotional reaction.

Past sickness does not, however, make any perceptible change in women, he says. For instance, influenza, which leaves a state of irritability in men, seems to implant no such result in women.

Doctor Gives Public Warning of Approaching Epidemics

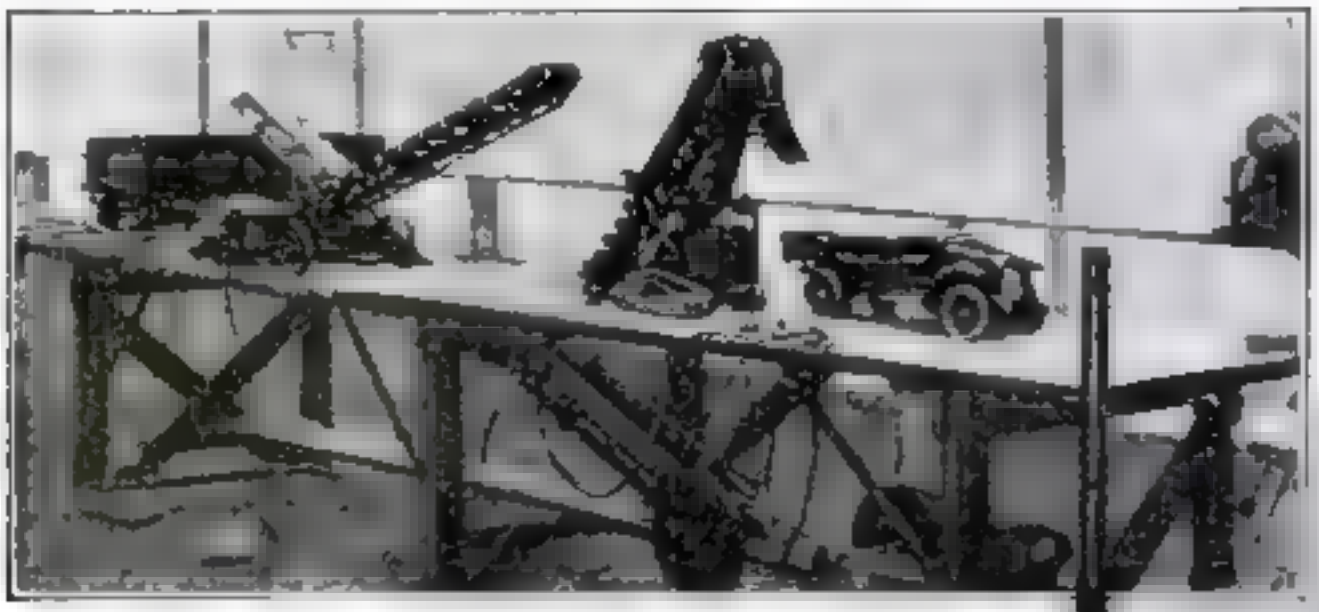
With this new elaborate chart of statistics, Dr. Herman Bundesen, Health Commissioner of Chicago, claims it is possible to predict the coming of any kind of disease to a community and that this will enable authorities to take the proper preliminary measures to fight it and stamp it out

Finds Giant African Tribe

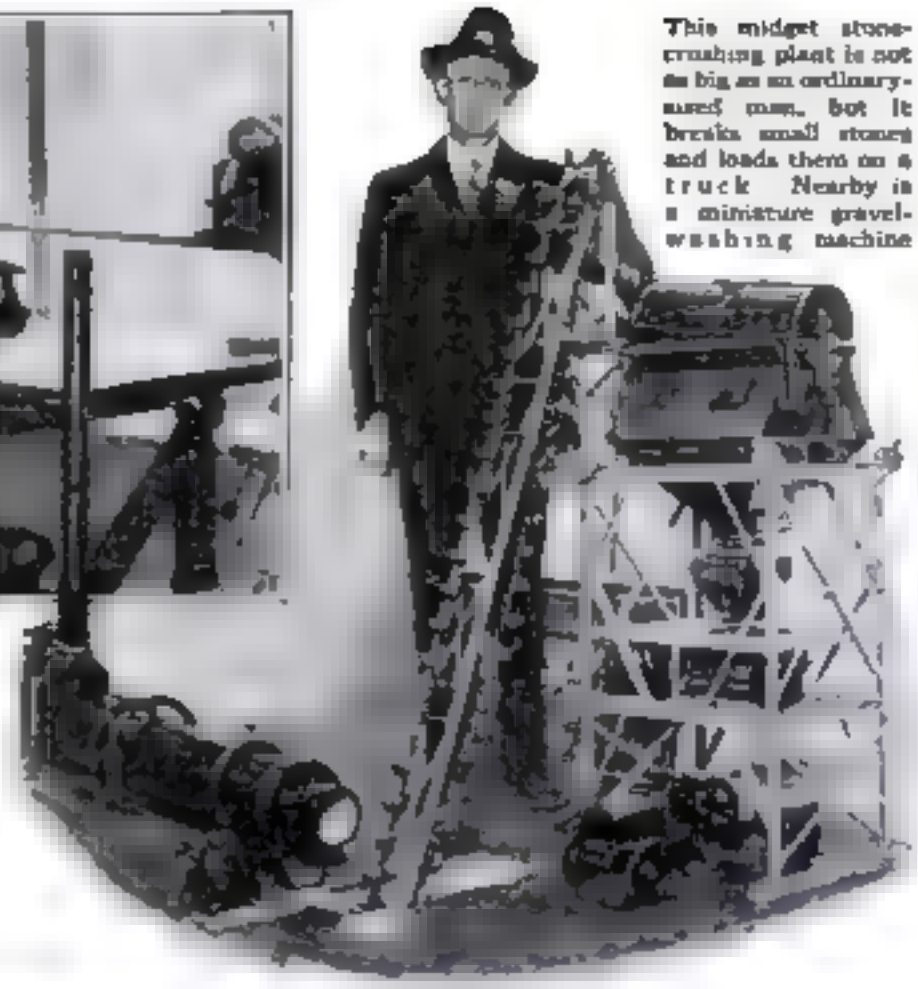
A NEW tribe of giant negroes, who are ruled by a seven-foot king, has been found in Central Africa, according to William J. W. Roome, secretary of the British Foreign Bible Society, recently returned from Africa.

The tribe comprises 2,000,000 persons, whose average height, he states, is between six and seven feet. The men are fond of athletic sports. With their height and strength, they easily surpass our best sport records, and would have no difficulty in carrying off the honors in the world's Olympic games. The ruling caste appears to have descended from ancient Egyptians who came to Central Africa by way of Abyssinia.

In striking contrast to these giants, Mr. Roome found in the northwest Congo a race of pygmies about four feet high.



A complete miniature sand outfit, with loaders, truck, railroad car, and conveyors, that performs all the work ordinarily done by the big equipment



This midget stone-crushing plant is not as big as an ordinary-sized man, but it breaks small stones and loads them on a truck. Nearby is a miniature gravel-washing machine

Tiny Models Show Machine Uses

Midget Pile Driver and Paving Outfit Give Demonstration

MINIATURE working models that demonstrate by actual operation the many uses of bulky machines are becoming increasingly popular at mechanical exhibitions. Not only do they save the expense of shipping and setting up tons of heavy equipment, but they often attract keener interest among spectators than would the full-sized machines. The appeal of tiny machines is universal. Everybody likes to watch them work.

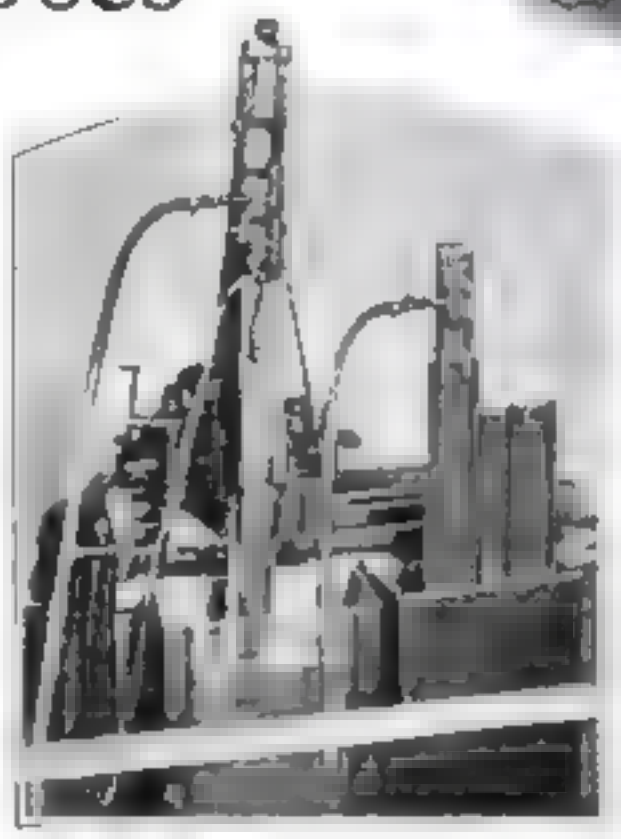
At the recent All-Western Road Show in San Francisco, the increase in the number of working models was noticeable. Many products usually exhibited in their standard sizes were shown in small reproductions that duplicated the operation of the big machines perfectly.

A miniature working model of a paving plant one-eighth the actual size, for example, actually passed the material through, drying and screening it. Crowds flocked around it, marveling at the speed and efficiency of mechanical road building.

A fully equipped midget stone-crushing plant broke up stones for concrete work, while a gravel-washing machine handled real gravel.

Two small working models of double acting pile drivers, engaged in driving miniature piles and sheet piling, drew thousands of interested people. One of the drivers was used in sinking wooden piles into sand, the top of the sand being about a foot under water. The driver was entirely submerged during the last stages of the operation. A heavy glass was placed across the front of the tank in which the piles were driven, thus enabling visitors to watch the action of the machine while working under the water. The other pile driver was engaged in forcing miniature sheet piling into sand placed in a metal tank.

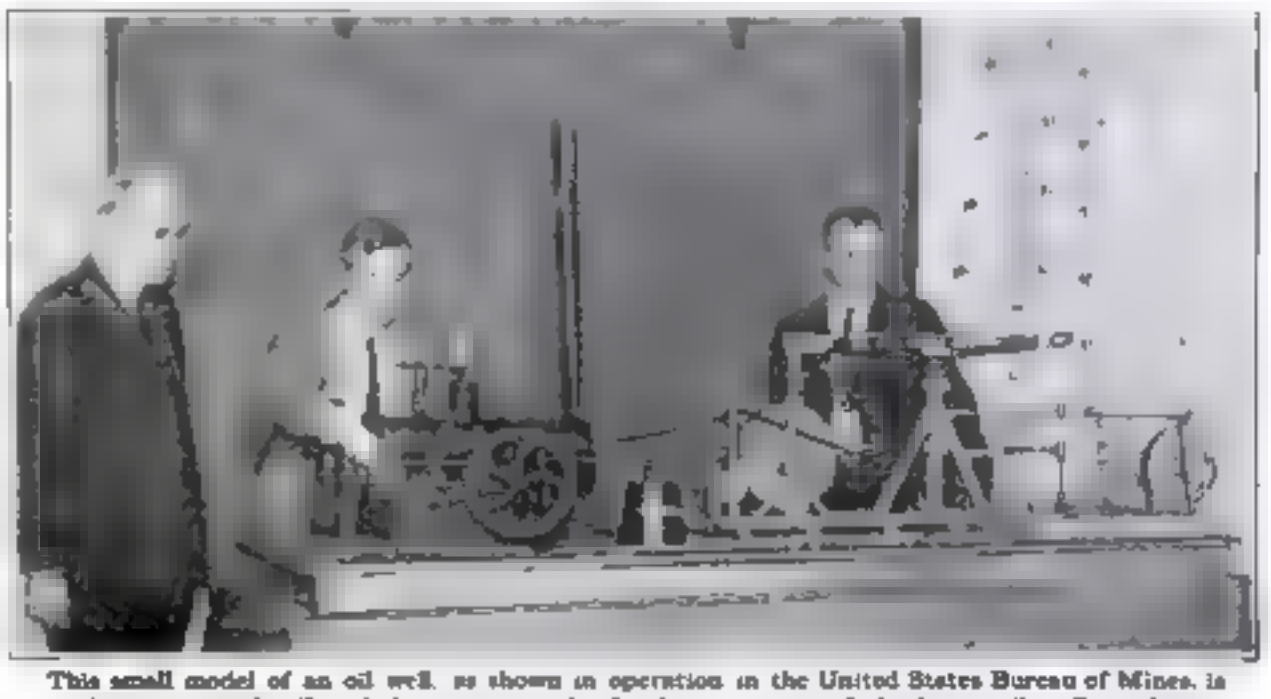
A little ditcher, wagon loader, and two conveyors were driven by small electric motors. The ditcher as well as the wagon loader actually picked up sand, the loader depositing it into a drop bottom miniature truck. The sand, passing down through the drop bottom, was deposited on a conveyor which delivered it into a gondola railroad car with a dump bottom. Passing through the bottom of this car, the sand then entered a second conveyor which deposited it beside the wagon loader. Once more the loader picked it up and deposited it in the drop bottom truck. This process continued as long as the motors were in operation.



The pile driver at the left forces small piles into sand under water, the glass tank enabling one to watch it work under water. Driver at right is used on short iron piles

In a miniature operating model of a scraper and cable way excavator, a scraper of one-fourth cubic foot capacity was used in picking up sand which was raised and deposited in a bunker. The sand then was passed down through the bunker and was returned by a second scraper to the starting point.

TO SHOW the workings of an oil well in operation, there is a miniature model of an oil well with full equipment in the United States Bureau of Mines. It is said to be absolutely perfect in every detail. The picture below shows this wonderful piece of mechanism being inspected by Edward C. Finney, Assistant Secretary of the Interior, and officials of the bureau.



This small model of an oil well, as shown in operation in the United States Bureau of Mines, is perfect in every detail and demonstrates clearly the operation of the latest oil well machinery

How Your Eyes Betray You

Testing for Fear Reactions

As the subject (above) looks into the pupilometer, the experimenter drops a heavy weight and the tester (left) makes a record of the dilation of the eye

WHAT happens to you when you are angry? What changes take place in your body when you are frightened or shocked?

To answer these questions, Mortimer J. Adler and George O. Schoonhoven, graduate students of the psychology department of Columbia University, New York City, have devised an entirely new instrument which they call a pupilometer.

This unique machine measures the dilation of the pupil of the human eye in its reactions to various emotions. The subject sits in a dark room, his eyes pressed against a sort of stereoscope, and looks into a large box covered with black cloth. A cap is fitted over his head, keeping his eyes fixed on the lenses. Strapped over his chest is a pneumograph to record his breathing. Over the left wrist is a rubber sack enclosed in a cloth band. This measures the pulse.

Behind him is an assistant, ready to take the blood pressure. Facing the subject, on the opposite side of the apparatus, is an experimenter, who observes the pupils of his eyes. The lenses are crossed with fine hair lines, so that the width and height of the pupils can be measured exactly, and the changes are recorded by adjusting screws on a small dial. The motions of the screw are set down on a rotating cylinder. The various parts of the apparatus attached to the subject end at this same cylinder, in little needles that make marks on the drum, as it goes around.

When all is ready, the drum is set revolving, and rows of parallel zigzag marks appear on the drum, showing the subject's normal breathing, his pulse, the normal size of the pupil, and the time.

Then, at a signal from the experimenter, the assistant standing behind the subject does something startling. He may shoot a pistol, drop a heavy weight, or send an electric shock through the subject's body. The subject's eye pupils dilate or contract, and this is recorded automatically on the cylinder at the same time with the other measurements. The pupil measurement is an accurate guide to the response of the nervous system to what excited it.

"At present no one really knows what an emotion is," says Mr. Schoonhoven. "If we can get variations in blood pressure, pulse, breathing and nervous reactions, we shall have facts from which to make valuable conclusions. The most difficult part of the experiments is to excite the emotions that you want to test. Shock is rather easy. But how to induce real anger is a problem."

The pupilometer is a modification of Weiler's apparatus, a German device.

Trying to Make the World a Better Place to Sleep In

Dr. H. M. Johnson, psychologist of the Mellon Institute of Industrial Research, with the assistance of twelve boys, "experimental sleepers," is making a study of the psychology of sleep and the effects of fatigue on industrial efficiency. In his tests, he is using an invention of his own, the chronoscope, which records all the sleeper's reactions and deduces from these his efficiency, alertness, energy and fatigue. Dr. Johnson is shown above, left, with his device, at right he is reading a chronoscope attached to a specially constructed bed in which lies an "experimental" sleeper

Artificial Flowers Now Made from Rubber

The picture at the left shows an English girl preparing a rubber stem for one of the new rubber flowers. Below, a flower maker is seen operating the die that cuts petals out of colored sheet-rubber, after which one girl cuts out a bird

POPULAR love of flowers long ago created a demand for artificial substitutes when nature's beautiful blooms were hard or impossible to obtain. We have had flowers of cloth, of paper, and of glass. Now still another material is to be used for making artificial flowers—rubber. The idea comes from London, where it has been favorably received. Already a considerable trade has been built upon it there.

Each petal of the desired flower is cut out of colored rubber with a sharp die, and the petals are assembled to form the complete flower which, with artificial leaves, is then added to an india-rubber stem. The brushed product is said to have a most realistic appearance.

Gasoline Stoves Are Popular with Camping Fans

GASOLINE camp stoves have greatly increased in numbers and kinds during the last few years with the growing popularity of outdoor life, because with them it is possible to have in a camp, far out in the woods, many of the comforts of home. Some of the models now on the market are really miniature kitchen ranges. On them can be prepared the same foods that are cooked at home on the big gas range. They have built-in ovens for baking, roasting or broiling, just as the camper wishes.

Apart from the cooking, the ovens, set up ready for use, make the finest kind of drum heaters to warm the tent or cabin on chilly weather. The illustration shows a camper getting the coffee and bacon ready on a small stove.

Film Stars' Faces As Numbers on Telephone Switchboard

SOME ingenious operator at the switchboard of the Universal City telephone exchange has thought out an easy way of remembering the stars' extensions without carrying a long list of numbers either in the head or on a written list. Photographs of movie stars whose phone lines enter the switchboard are pasted on the board in such a way that each photograph appears directly above the hole, or jack, where that star's line is plugged in.

The illustration, a close-up of this unique arrangement, shows how photographs are actually used instead of numbers. How many of the faces do you know?

Gyroscopic Eye for Tank Crew

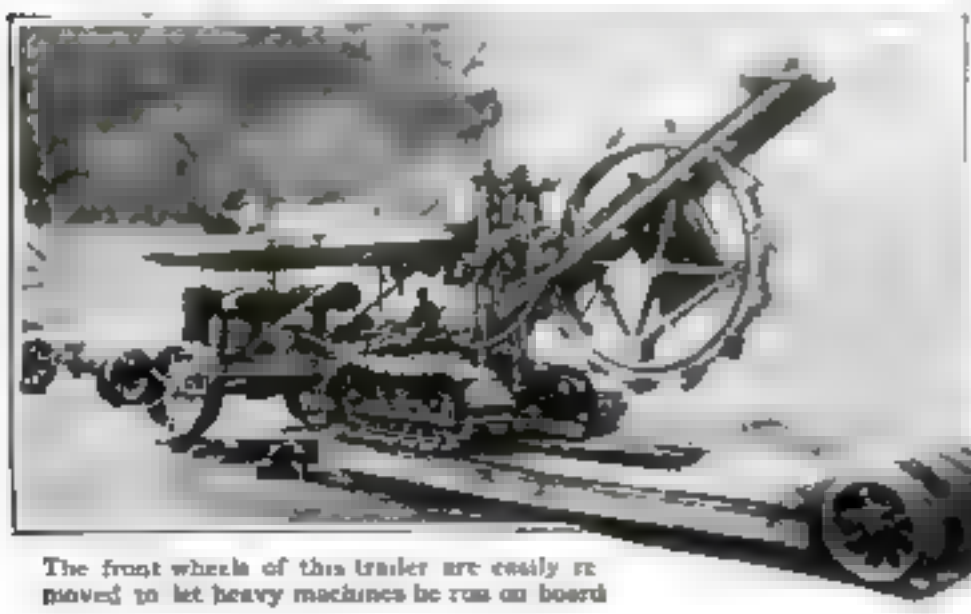
THROUGH fire, gas, fog, mist, rain or hail, a tank can be kept to a safe course without the crew's having to get out to take its bearings, when the new gyroscopic "eye," being perfected by army scientists at Baltimore, is installed.

This "eye" is a device attached to the tank's machinery that indicates just where the tank is on a map, drawn to scale, of the land being crossed. It is controlled by a compass on the rear of the tank. As the tank moves, its exact path is marked with a needle on the map.

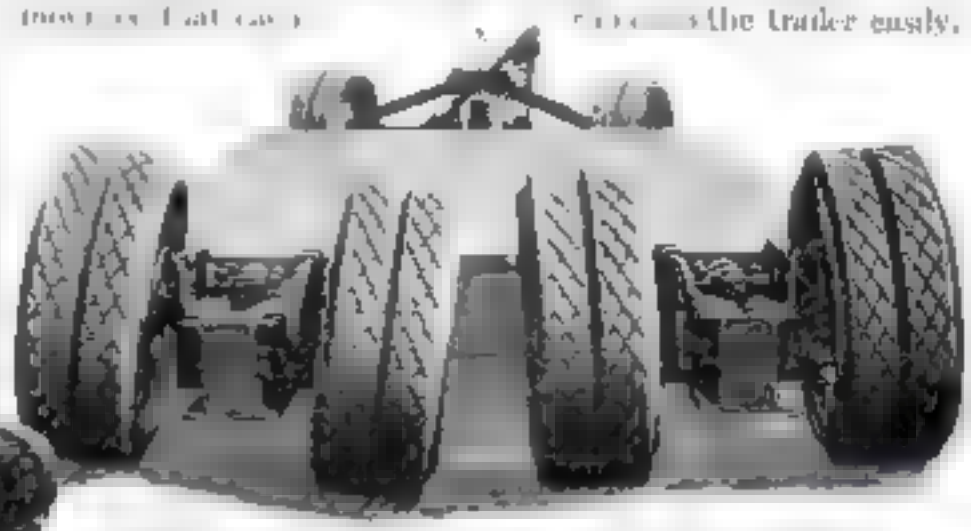
Giant Six-Wheel Trailer Carries Heavy Road Building Machines

THE ditch-digging machine in the illustration at the left below rides to work on a trailer specially built for the rapid transportation of the machinery used by road builders. These machines, under their own power, move very slowly, but by the use of the trailer they are quickly taken to the job. Moreover, the rubber-tired wheels of the trailer are not so hard on the roads as the heavy machine.

The trailer has brakes on all four wheels, which are so [illegible] pair, as seen in the right-hand illustration, can turn without the other when irregularities in the road surface are encountered. A single lever on the front of the trailer controls the brakes. The front axle assembly is removable by the pulling of a large bolt, to allow the machines to be [illegible] the trailer easily.



The front wheels of this trailer are easily removed to let heavy machines be run on board



Each pair of giant back wheels is on a seperate swivel and turns independently of the other, thus making riding easy

Old Auto Tires Make Shoes for Spanish Peasants

DISCARDED auto tires are used for many purposes, but the latest way is perhaps the most useful of all. They are now made into shoes that are worn by Spanish peasants.

To avoid import duty, the tires are cut up in suitable lengths and shipped to Spain, where they are transformed into the type of shoe illustrated above. Plies stripped from the sides furnish the stock for the toe-cap straps and heel counter. The various parts are fastened together with staples. A lot of extra mileage is thus obtained from the scrap tires.

Similar shoes are worn by the Chinese and by native blacks in South African diamond mines.

New Alloys Give Fine Glaze

A NEW method for alloying aluminum with other metals, which produces a surface resembling glazed porcelain, has been discovered, it is reported, by B. M. Jirotka, a German electrical engineer who recently demonstrated it to a commission of metallurgists in Berlin. The new alloys are of especial value to the automobile industry in the painting of bodies. By the Jirotka process, it is asserted, a body surface can be obtained which will withstand hard usage, will not show scratches, and will have both color and finish built in, thus doing away with the expensive painting generally necessary.

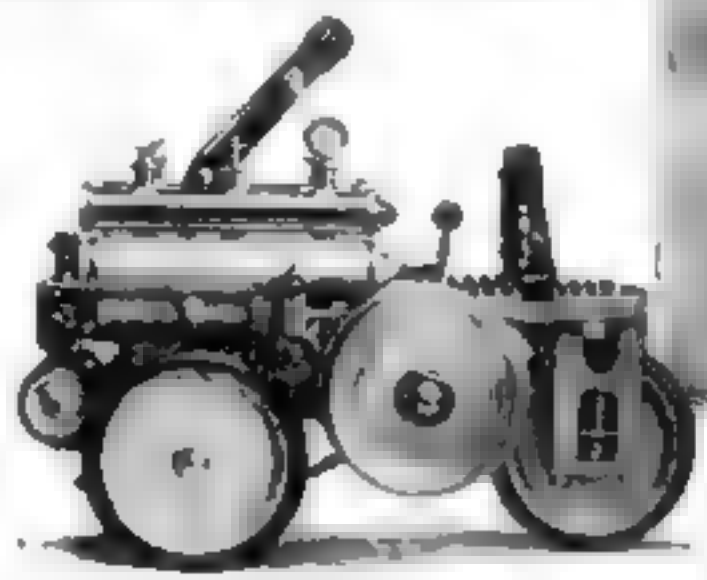
Jirotka is said to have made alloys of aluminum and more than a dozen other metals of varying colors, and has produced some wonderfully beautiful effects.

22 Miles an Hour on Motor Roller-Skates

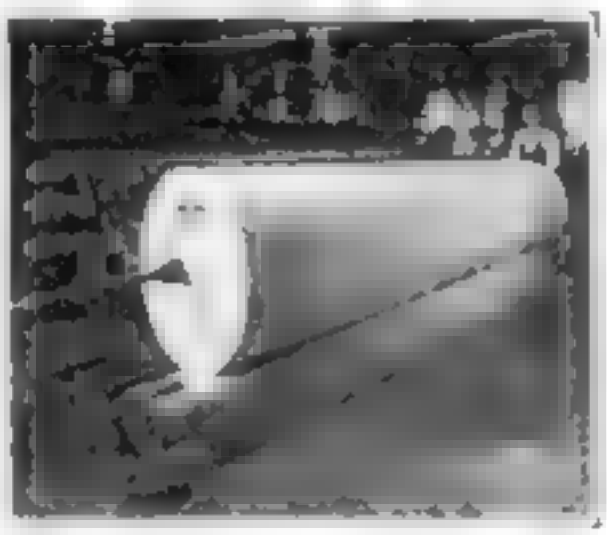
MOTORS small enough to run roller-skates are the remarkable achievement of Gebhardt, German engineer, who for many years has been experimenting with midget motors. This newest model uses acetylene gas for fuel, making it possible to build them with minimum weight and bulk.

The motor is oiled automatically, is water-cooled, and has a unique ventilating system. Power for six hours with a speed of from eighteen to twenty-two miles an hour costs only about two cents.

Gebhardt recently installed one of these motors in a small aeroplane with collapsible wings that runs for the cost of a motorcycle. The picture at right shows him on his motor-driven skates.



At the left is one of the ingenious roller-skates equipped with miniature acetylene motors, that carry one along at a rate of eighteen to twenty-two miles an hour



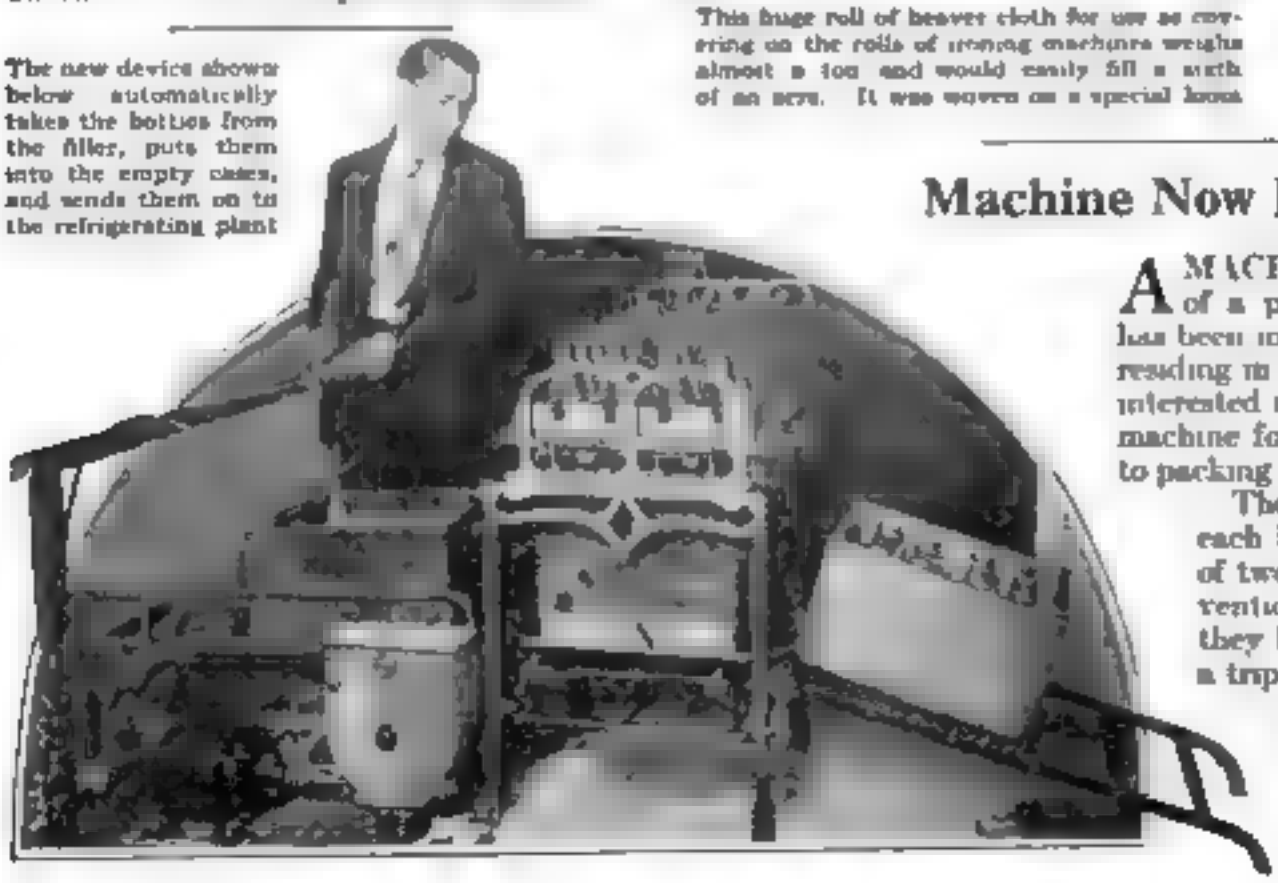
This huge roll of beaver cloth for use as covering on the rolls of ironing machines weighs almost a ton and would easily fill a sixth of an acre. It was woven on a special loom

Giant Roll of Beaver Cloth

THE increase in the number of ironing machines for flat work used by laundries throughout the United States has given a new impetus to the manufacture of beaver cloth. The rollers of the machines, to work efficiently, must be covered with a material that will seize the clothes and carry them through. Tests have shown that beaver cloth is best suited for this purpose, for durability and clinging qualities.

The illustration at the left shows a gigantic roll of this useful material weighing 1,850 pounds. The cloth is 120 inches wide and 650 feet long. Six rolls like the one shown would cover a whole acre. To weave such an enormous piece of goods, it was necessary to build a special loom.

The new device shown below automatically takes the bottles from the filler, puts them into the empty cases, and sends them on to the refrigerating plant

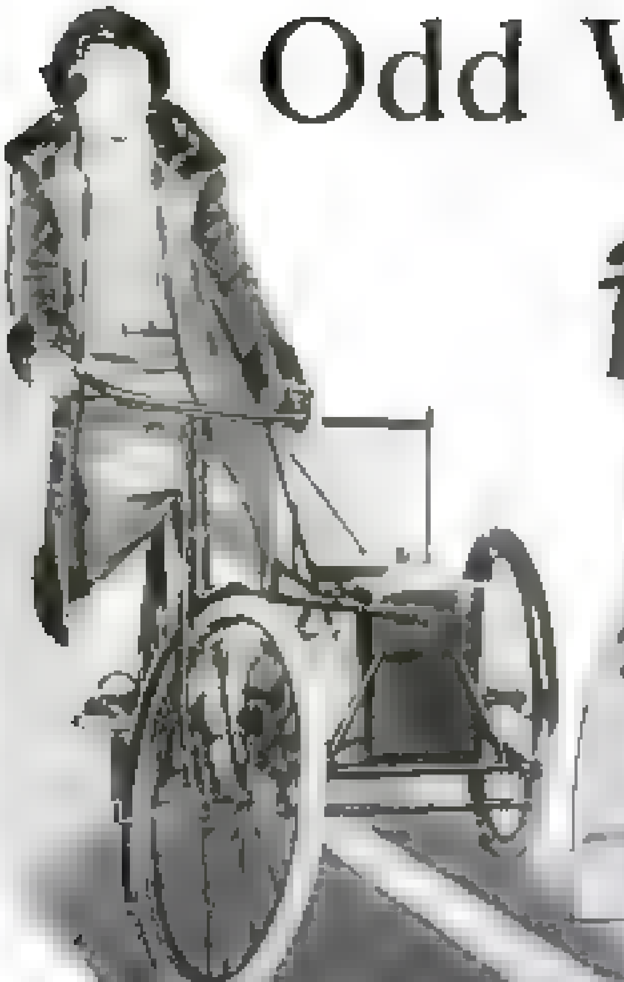


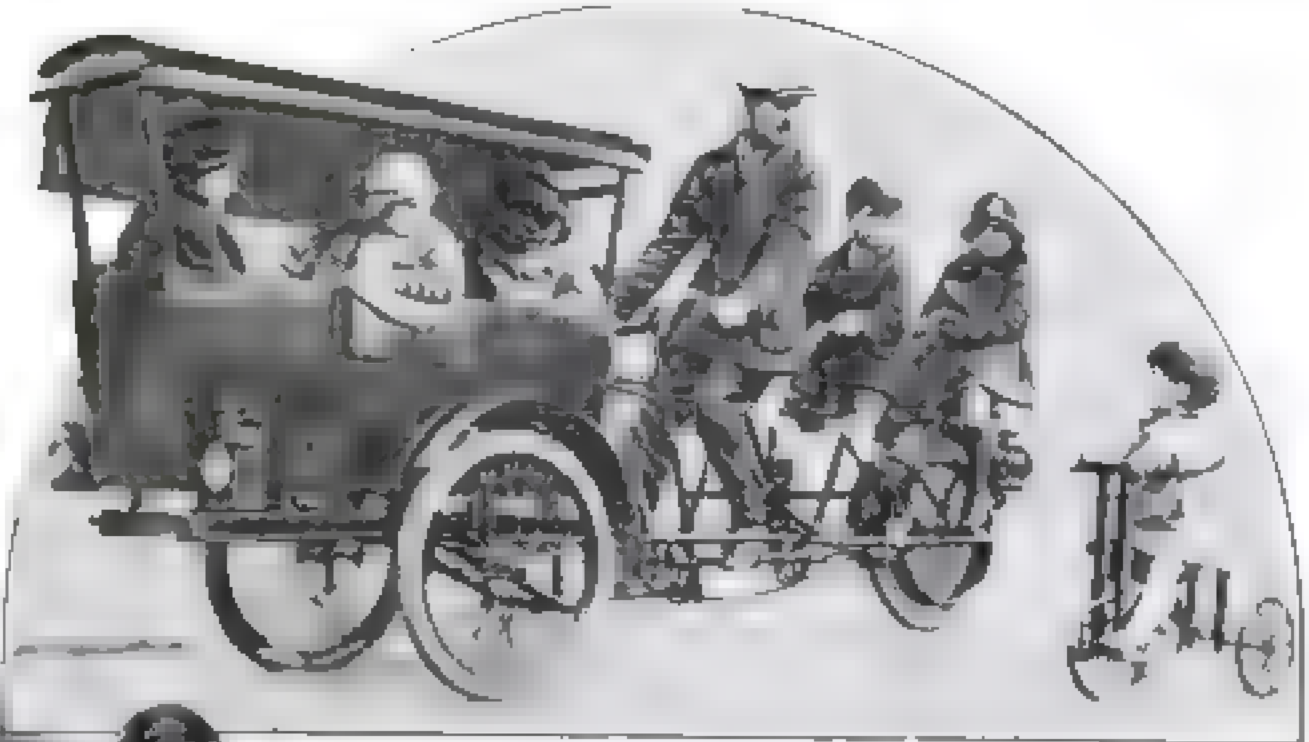
Machine Now Packs Bottles in Cases

A MACHINE for packing bottles that seems certain of a prompt reception in the bottling industry, has been invented by Carlos Dulche, a Mexican youth, residing in Los Angeles, Calif. For many years, those interested in the bottling business have been seeking a machine for the automatic conveying of filled bottles to packing cases.

The filling of cases now is usually hand-operated each bottle-filling machine requiring the services of two men to handle its output. This recent invention, mechanically simple, takes the bottles as they leave the filling-machine, arranges them on a trip platform, and deposits them in the empty crate. It feeds the empty crates into the machine and places the filled cases on a conveyor that leads to refrigerating rooms. The use of this new machine, it is said, will reduce expenses, and speed-up production.

Odd Ways to Use Bicycles



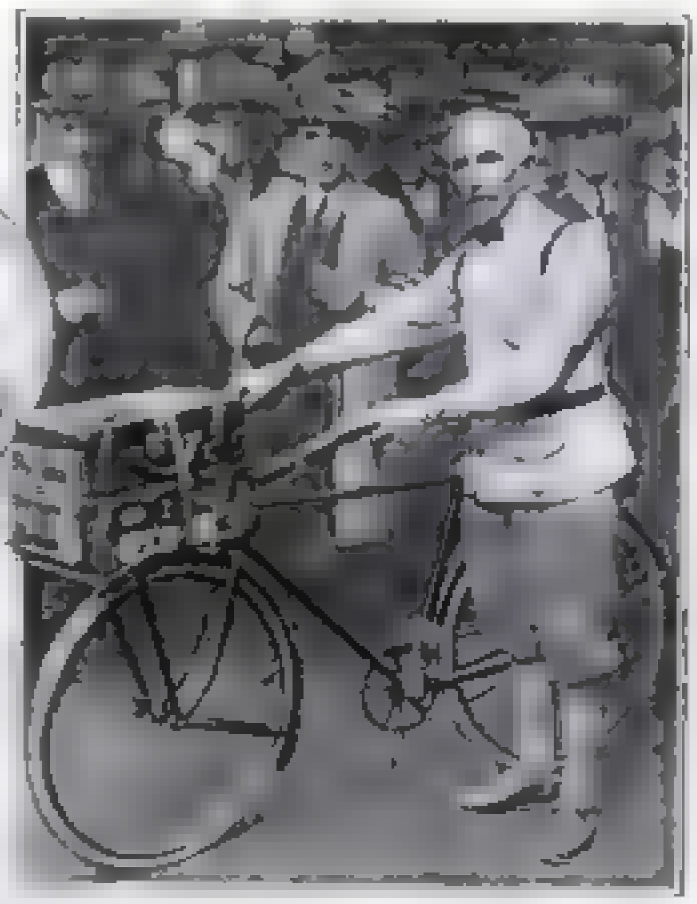


A Tricycle for the Whole Family

The children all wanted to ride on the handlebars of the [illegible] bicycle, but they had [illegible] too long for [illegible] J. W. [illegible] of Highbury, England, built a [illegible] shown above, big enough for the whole family. The vehicle is twelve feet long and has a detachable roof and side [illegible]

Marks White Traffic Lines on Road

White traffic lines are quickly and neatly made on road surfaces [illegible] by a bicycle with [illegible] having a [illegible] on the road. It [illegible] the [illegible] side of the highway



Rode 28 Years

Mrs. Mattie Thomas, 51, a [illegible] the Evening [illegible] Daily [illegible] recently [illegible] has used the same [illegible] for twenty-eight years [illegible] her news [illegible]

At 71, Rides 4,200 Miles

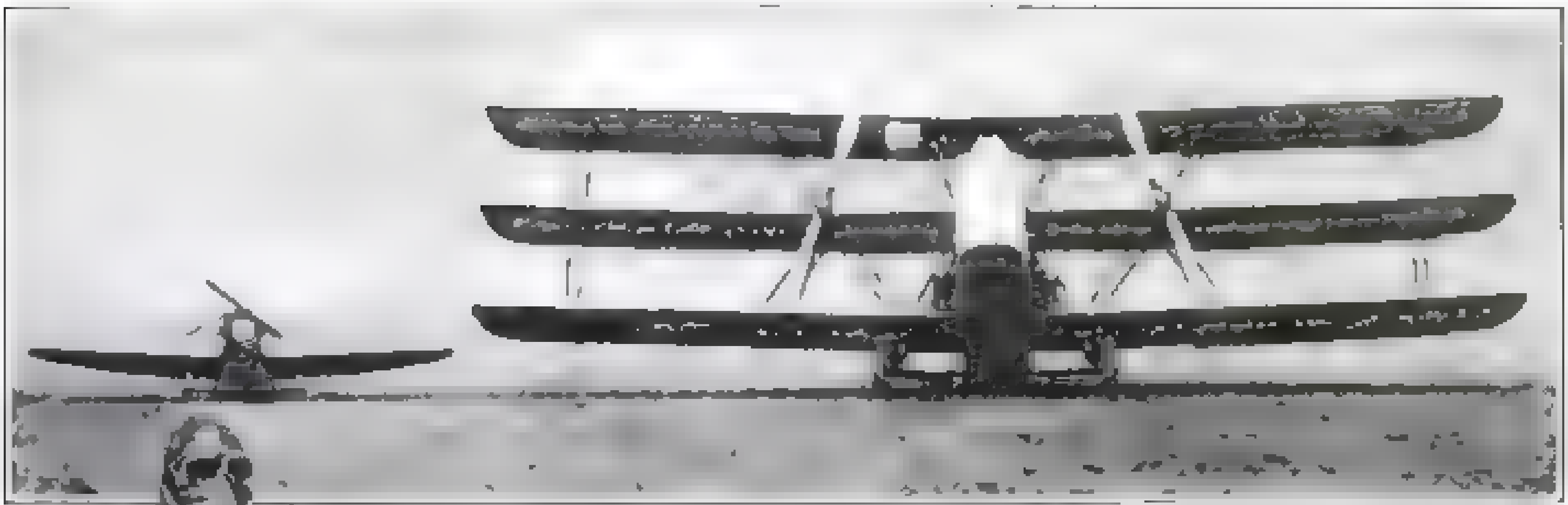
M. C. Plummer, 71, of Boston, above, recently made a [illegible] bicycle in San Francisco, [illegible] having [illegible] he en route a distance of 4,200 miles. He averaged [illegible] 150 miles a day and [illegible] He [illegible] to start [illegible] via the Panama Canal

Use Ski-Cycles to Patrol Beats

Shown above is the novel and very practical ski-cycle used by Norwegian policemen in covering their beats in the winter months when the heavy snows almost bury the cities of Norway. It is a bicycle mounted on skis and propelled by a series of grippers attached to the back wheel. It enables the police to patrol the streets regularly with comfort and at much greater speed

Stops Jolting

Left: Here is a new type of bicycle that recently made its appearance in Paris. It does away with bumps. The seat, instead of being supported on a frame, is suspended on a [illegible] attached to the front of the frame as shown here



The picture shown above offers an interesting study in extremes in sizes of airplanes that are built to meet the varying demands of modern aviation. At the left is the British Parnall Pixie, said to be the lightest and fastest plane in the world, while on the right can be seen the [illegible] triplane with two propellers, the Parnall Possum

Airplanes Big *and* Small

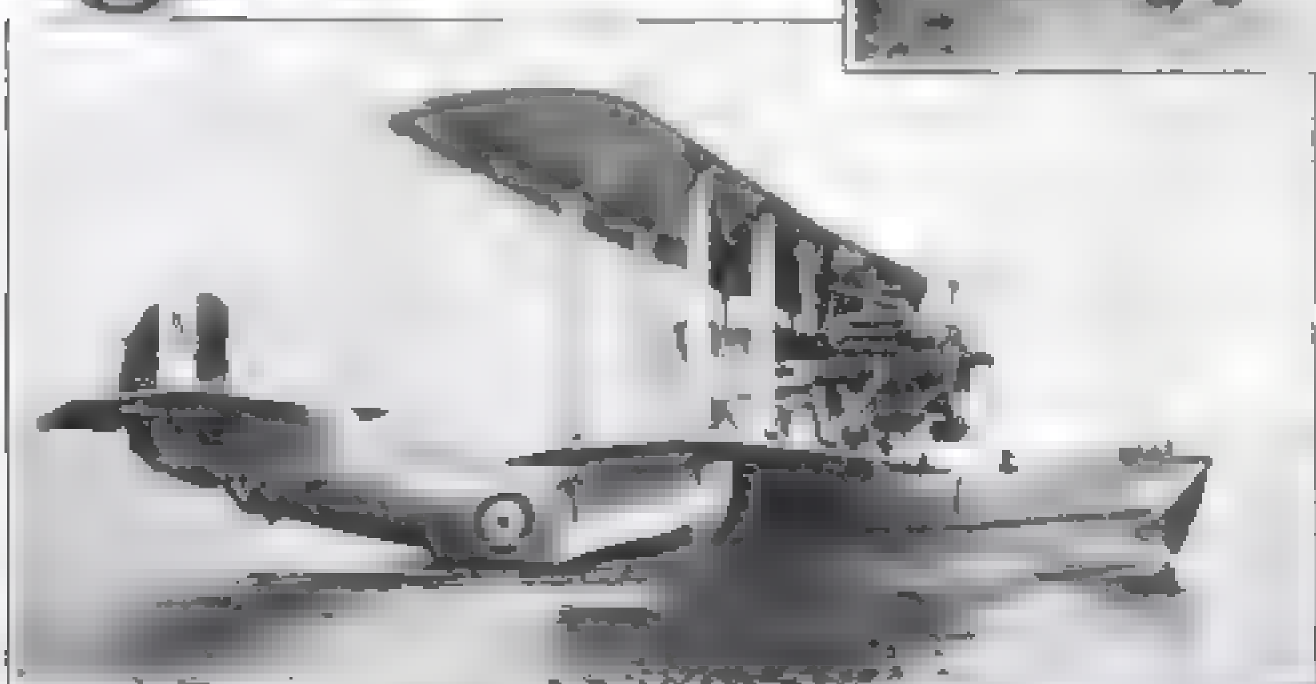
Altitude Ace Still Hopes to Beat Record

Macready In Air Togs

Lieutenant John A. Macready, the famous army aviator, recently flew to a height of 35,900 feet, breaking the American record of 35,239 feet. He fell short, however, of the world's record set by Callizo of 39,596 feet. His engine charger, which began to fail at 33,000 feet, ceased to function at 35,900, and he had to descend. The picture shows the altitude ace in his electrically heated suit and breathing mask

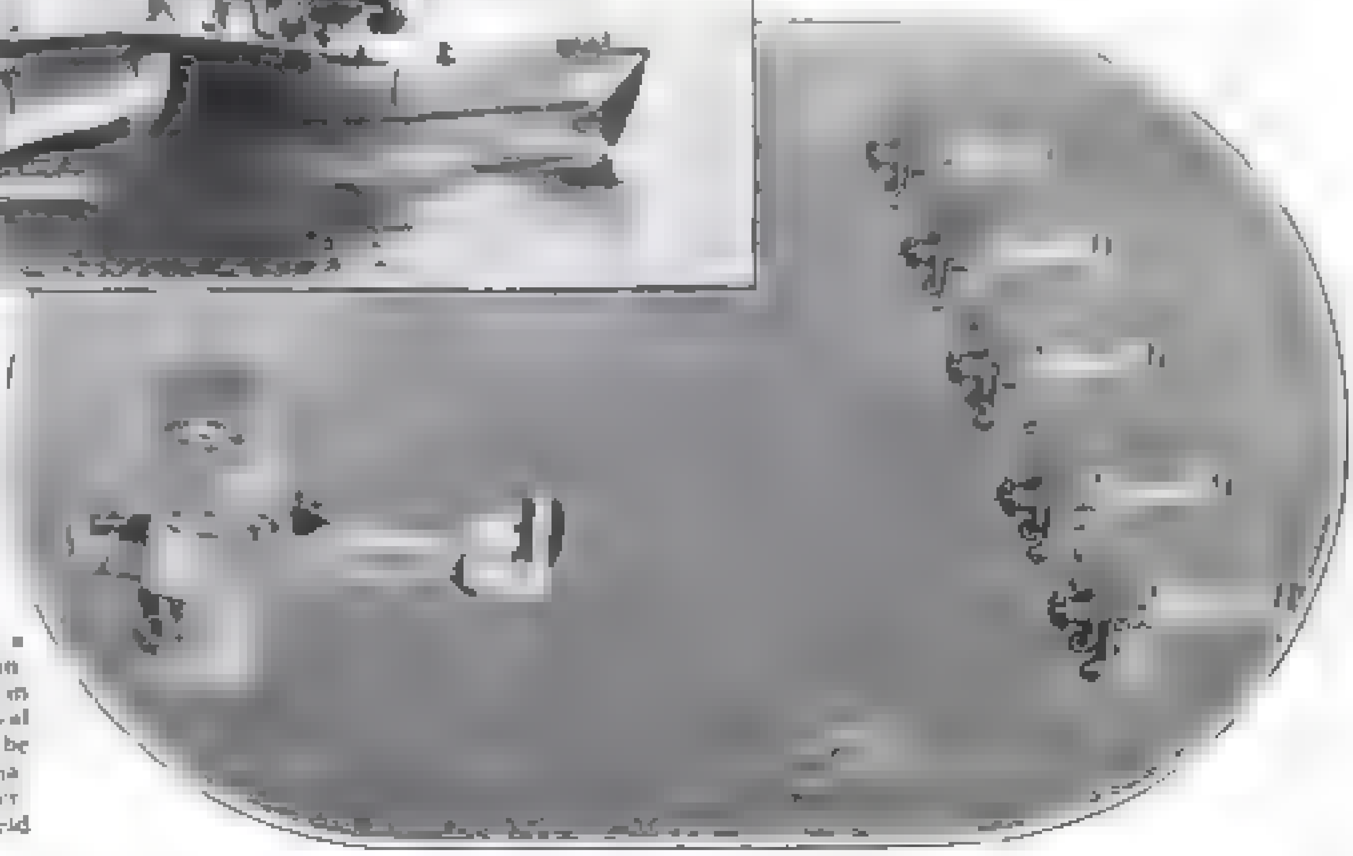
Hold Meet for Midget Models

The illustration above shows some of the miniature airplanes entered in the first aviation meet of the Scientific Club, a new organization of Southern California boys and young men interested in making and flying toy airplanes. Flights true in details to the big planes amazed visitors at the meet



Plane Has Metal Hull

The huge seaplane shown above recently completed a test flight of 500 miles along the coast of England. Its hull is made entirely of duralumin and it is [illegible] feet [illegible] wing span. The plane has two engines of 1,000 horsepower each. It belongs to the Royal Aviation Forces



Navy Planes in Battle Line

The unusual photograph at the right of a squadron of navy planes was taken from another plane higher up. It shows the planes in battle formation during combat flight in naval maneuvers over the Pacific just above the naval air station at San Pedro, Calif. Aviation experts have commented on the exactness with which the line formation is held

Tiny Road and Cars Test Driver's Skill

A MINIATURE roadway with tiny cars operated by levers has been devised by Dr. Morris S. Viteles, psychologist, of the University of Pennsylvania, to test the alertness and quick-thinking powers of chauffeurs applying for a license to drive automobiles.

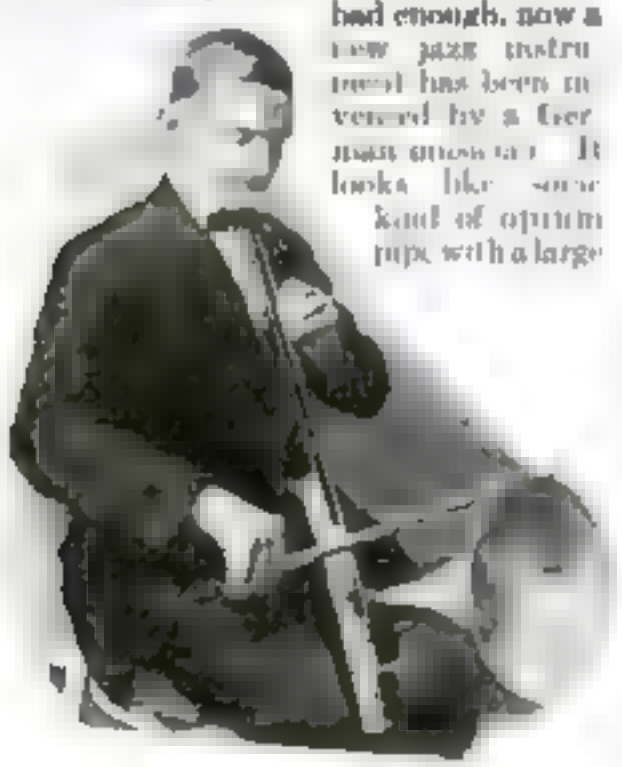
Sitting at a lever controlling one of the cars, the applicant for a license directs one of the little cars which follows another car operated by the examiner. The road has all the problems of a real highway,—curves, crossroads and ditches, stopping and backing. To drive the little car without mishap requires a good deal of intelligence and quick thinking, and is a fair test of a prospective driver's mentality. Automobile examiners who have witnessed the tests are said to be favorably impressed.

In the illustration here, Dr. Viteles may be seen testing an applicant with his novel apparatus. The latter sits at the lever.

Testing autoist's mental fitness with miniature roadway and cars

Now the Saxophone-Fiddle!

THE jazz craze is responsible for some queer melodies that are catchy and haunting, but do not live up to any rules of accepted classical standards. It has also brought into existence some odd-looking instruments to produce these weird sounds. The saxophone comes to mind immediately as one of the offspring of our national music. As if that were not bad enough, now a new jazz instrument has been invented by a German musician. It looks like some kind of opium pipe with a large



funnel for a bowl, and it sounds like a saxophone. The horn is of aluminum, and surmounts a hollow flute-like pipe. One string played by a violin bow supplies the music. In the picture Herr Ehan, its inventor, is shown playing his odd instrument, which is called a "trichtergeige."

Dress Stuff from Ostrich Down

SOFTER than the softest silk or wool, with a pliability greater than any known cloth, is the new material invented by a noted Paris garment designer. It is made, it is reported, from the fluffiest ostrich feathers, which are plucked from the quills, treated by a special process which only the inventor knows, and then woven into a cloth. The finished product is lighter in weight than the finest down, and resembles thistledown, after which it is named.

Although it is phenomenally light in weight, it is very durable, and is capable of effects in colors and patterns that are difficult to obtain in the materials now in common use.

This Plaster Deadens Noise

A NEW sound-absorbing plaster recently invented by Dr. Paul E. Sabine of Geneva Ill., will it is claimed, revolutionize modern hospital construction, one drawback of which has been noise. This plaster absorbs, it is said, from eight to ten times as much sound as the ordinary plaster.

It is reported to be excellent for smothering high pitched tones, even the wailing of infants—and is for that reason desirable in hospital construction.

Medicine Dropper of Rubber

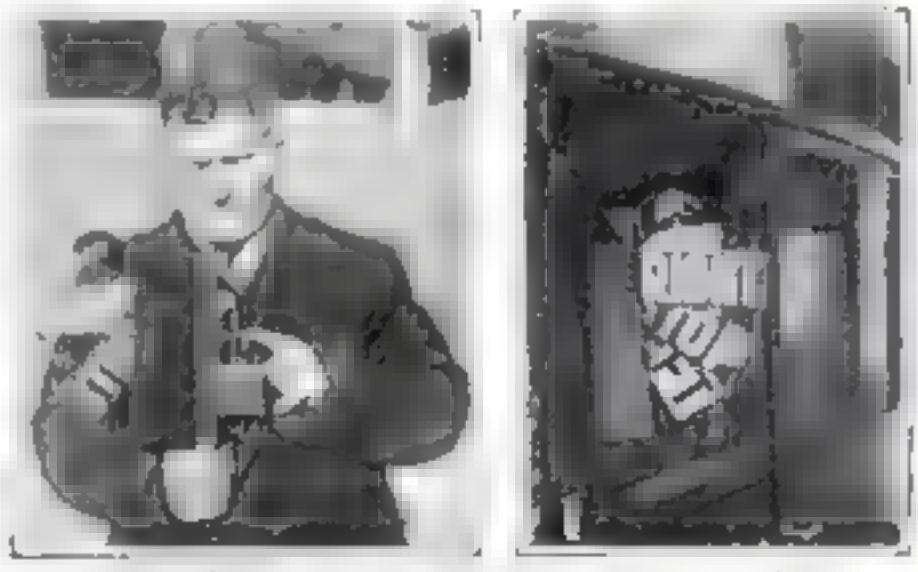
AN UNBREAKABLE dropper has been long wished for by everyone who has to use medicine that must be doled out in drops. Such a dropper has recently been put on the market. It is made of rubber and is shorter than the old glass tube style. It is especially useful, it is claimed, when putting medicine in the eye, since its point, too, is rubber, thereby eliminating danger of injuring the eye.

To fill with medicine, the dropper is inserted in the neck of a bottle and the bottle turned upside down. It delivers only a single drop at a time when its bulb is pressed at the bottom.

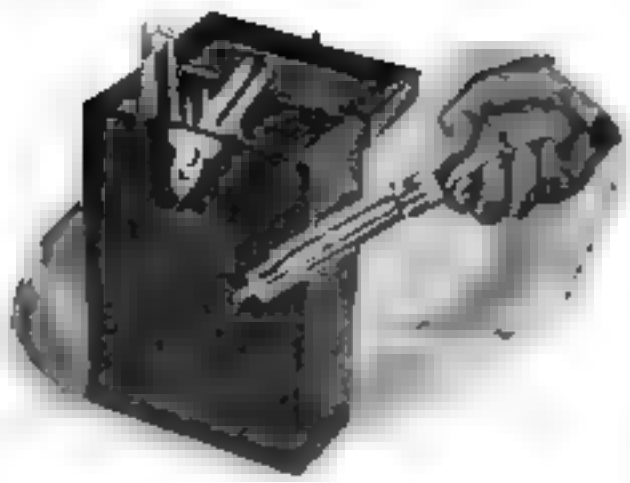
Sign Device Stops Hand Signaling

STICKING the arm out of a car window to warn cars behind is a signal that may be easily misunderstood and result in a serious crash. It is dangerous, too, for the driver has to guide the wheel with one hand, and runs the risk of having it torn suddenly out of his hand by obstructions, or a slippery roadway. Then, again, everyone in the car wants to signal. So inventors are forever trying to find a way to stop hand signaling.

D. M. Susi, of Pittsfield, Me., shown in the illustration, has invented a useful device, consisting of three signs — right, left, and stop—operated by buttons which are within easy reach of the driver when the device is attached to the side of the car as shown at the right, below. An electric light at the top of the sign makes it easy to read at night and eliminates the glare that is made by various colored stoplights.



Pressing a button makes the sign appear instantly on this new auto signal, which is attached to the window close to the driver



Simple Device Shows Presence of Carbon Monoxide Gas

THE DETECTION of small amounts of carbon monoxide in the air is an important problem in ventilating engineering.

Carbon monoxide is likely to exist anywhere, and a small amount caused by a leaky gas stove, imperceptible because it has no odor, may cause sickness after a long period of time.

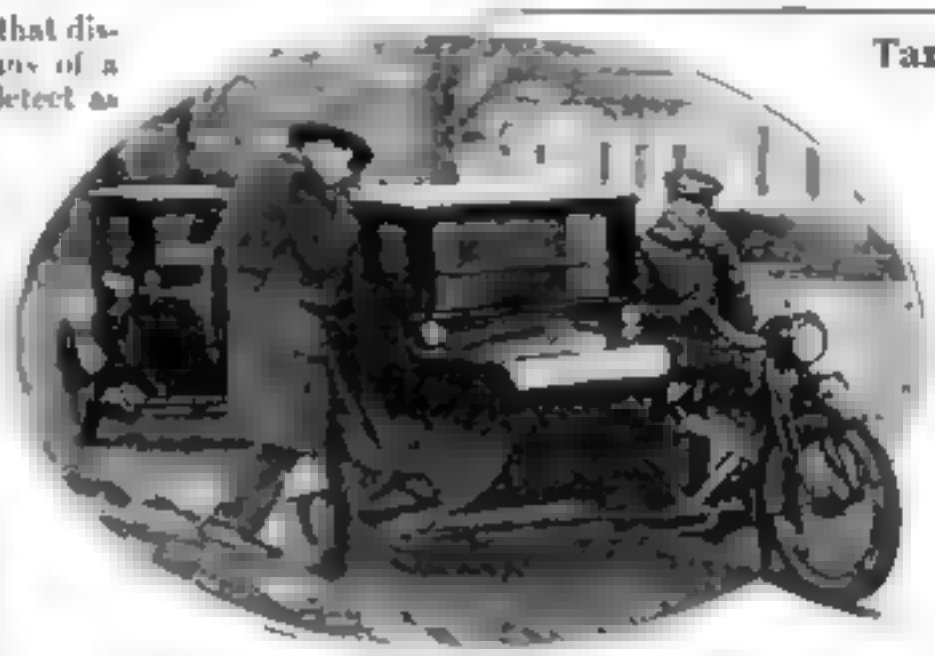
A simple device, shown above, that discloses carbon monoxide by means of a color test, makes it possible to detect as minute quantities as 0.1 percent. A sealed glass tube containing iodine and other chemicals is inserted in a tube of activated charcoal and a rubber hand bulb.

The charcoal removes all gases from the air stream except carbon monoxide. If any of this is present, it frees the iodine in the tube of chemicals, changing the color in the tube from light gray to blue or green. A glance at a color scale fastened on the tube tells the exact percentage present. These color indicators may be used by rescue workers entering a mine after an accident.

Paper Used for Money Gets Severe Tests

THE United States Government is most exacting as to the quality of the paper it uses for currency. Samples are carefully examined and tested so that only the best possible may be employed.

At the United States Bureau of Standards, in Washington, are several interesting machines for testing money. One of the newest is illustrated here. The photograph shows R. E. Lofton, one of the optical experts, examining paper to detect any spots, stains, blemishes or other defects that might be in it and might cause flaws in printing. Since a bill must be printed on both sides, he looks, too, to see whether the paper is opaque enough, even though light in weight. A special machine determines whether a bill is tough enough to resist tearing. The register on this device records the greatest stress that each specimen could withstand without tearing.



Entering the new two-passenger taxi

Taxis Made for One or Two

THE GREATEST part of the taxicab business consists of carrying one or two persons, who pay for all the unused space.

Melville Stevenson, in the taxicab business for the past twenty years, thought this over, and decided that the regular taxis take up too much room on the streets, are expensive to run, and are seldom filled to capacity. Why not make the taxi for one or two passengers?

He worked out an idea and recently Baltimore beheld ten little motorcycle taxis, big enough for two persons, with the driver outside, put into regular service. Each consists of an enclosed sidecar of special design, attached to an ordinary motorcycle. It rests on a wider and stronger chassis than that used for the usual run of motorcycle sidecars and is upholstered like a regular taxicab. Its weight is 800 pounds, making it easy on tires.

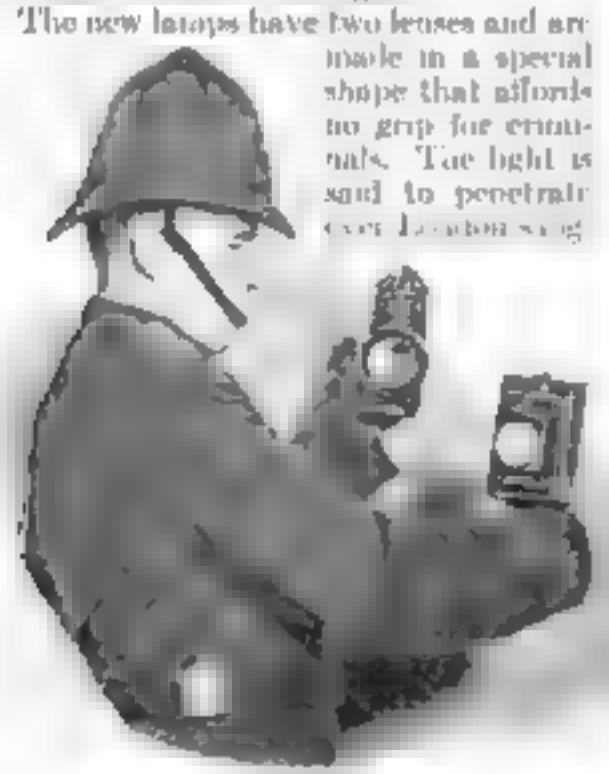
The new cab can be operated at rates much lower than the ordinary taxicabs; it is easy to drive in traffic, and takes up less parking space.

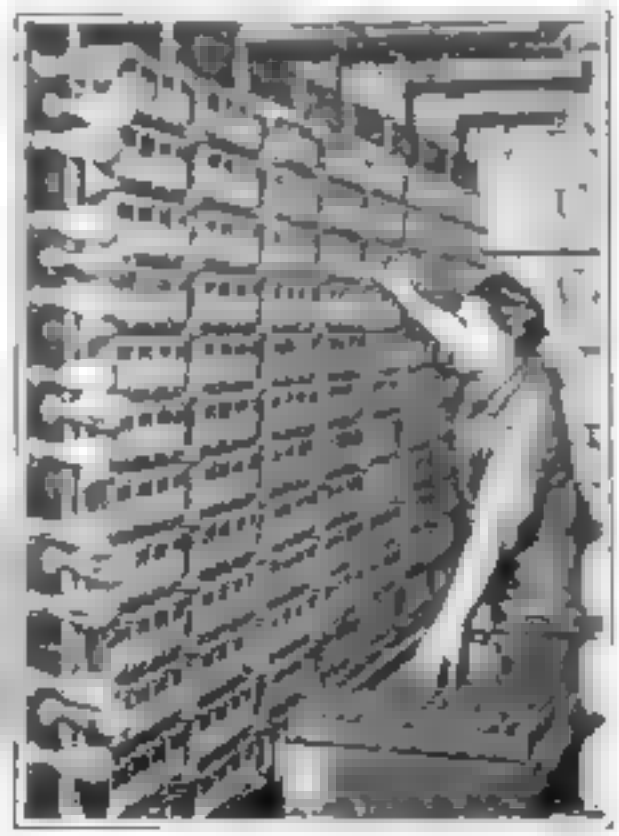
London Bobbies Lose Old Bull's-Eyes

THE LONDON policemen all marched in the other day and traded their old "bull's-eyes" for new electric lamps. And with this change came more safety, for in the old days the first thing a crook did was to [illegible] the light.

The new lamps have two lenses and are made in a special shape that affords no grip for criminals. The light is said to penetrate [illegible]

In the left-hand photograph a "bobby" is comparing the old with the new. In the other photograph, lamp batteries are seen being recharged at Scotland Yard.





A policeman compares the old bull's-eye and the new electric lamp; at the right, lamp batteries are shown on charging lines in Scotland Yard. The lamp is a great improvement on the old one

Relief Near for Sea Bathers

A NEW invention promises relief for sea bathers along our coast. For many years, since the introduction of oil as a fuel for ships, the waters at some beaches have been covered with a thick film of gummy black oil that took all the pleasure out of bathing.

While the oil was a nuisance for bathers, it denoted a distinct loss to ship owners, who called upon their experts to stop the loss. In answer to this appeal, marine engineers have perfected a device that recovers lost oil by a suction process, and with a separator removes the sea water, and leaves the oil fit for use.

This new machine will also be a blessing to sea birds, many of which have been drowned when their wings became gummed with the treacherous waste oil.

Geyser Steam Cooks Meals for Tourists

A steam gage showing the pressure of the natural steam plant. Right: Campers cooking meals over nature's stove

MOTOR campers near Healdsburg, Calif., this year need have no worry about fuel for stoves. All they require for cooking is a kettle and coffee pot such as the girls at the right are using. Nature has provided fireless cookers in the form of steam wells which give a tremendous amount of heat.

Geyser Canyon with its spouting steam is one of the marvels of the world. It was discovered by a hunter in 1847. But not until three years ago did anyone succeed in harnessing the tremendous power going to waste here. Wells are now being drilled some 200 to 300 or 400 feet deep and iron steam pipe casings with large central valves put in. The pressure from these wells runs as high as 150 pounds to the square inch.

The canyon is full of boiling springs. POPULAR SCIENCE MONTHLY for June, 1925, described the first successful attempt to run an engine from the natural steam.

No Caps in New Bridge Work

A NEW clasp for removable bridge work that does away with unsightly clasps on the front teeth has been invented by a New York dentist. The bridge is held in place by a cast clasp and a "lock-in" attachment buried in the front tooth so that it is hardly noticeable to the most observing person.

A gold inlay with a round hole is set in a cavity made in the side of the front tooth adjoining the space where the bridge is to go. A platinum and gold rod attached to the bridge fits in this round cavity exactly. An open clasp is adjusted to the rear tooth, the bridge is set in place and the new lock-in attachment is snapped into position. The bridge remains solidly in place, but by pulling the small bar it can be removed without the slightest inconvenience.

Tells How Much Space Paint Will Cover

THE little instrument shown in the illustration at the right measures the thickness of paint, and is used by the United States Bureau of Standards at Washington, D. C., to determine the covering power of paint. The results of the tests give paint makers and users standard measurements so that they can tell how much paint should cover a certain given area. These figures are extremely useful in making estimates on painting jobs.

The Bureau of Standards made another discovery while it was making tests of paint. It has found that finger prints can be detected with a photometer through three thicknesses of paint. This, it is thought, will prove of great value in tracing criminals.

New Wool for Navajo Blankets

IN ORDER to get beautiful wool for their blankets that is not too fine and is of varied color, Navajo Indians in New Mexico are breeding a new kind of sheep, a cross between the rare Karakul sheep from Asia and the native sheep. Successful experiments have given a big impetus to this movement which may produce a better and more beautiful blanket.

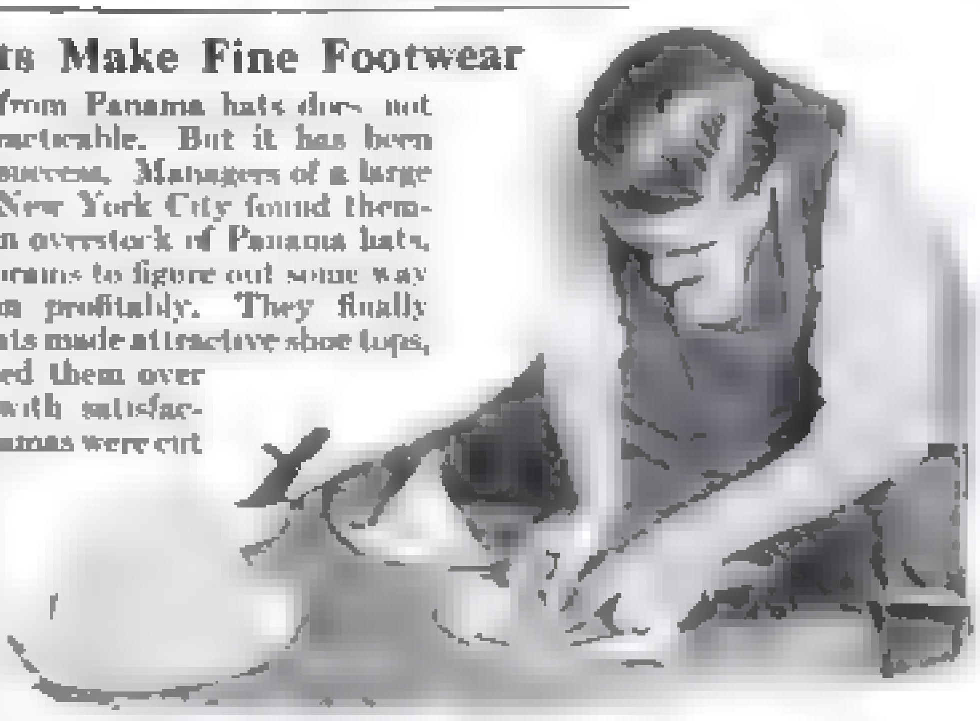
The Karakul sheep is the animal that supplies the fur known as broadtail, astrakhan or Persian lamb. The crossing of this animal with the Navajo sheep brings a new grade of wool of varying shades of tan, yellowish brown, and reddish brown that are excellent for the famous blankets.

A Lock Stopper for Bottles

A STOPPER with a key that locks a bottle is an interesting new device, shown at the left, that promises to keep persons from "helping themselves." The only way to get anything out of a bottle with one of these locks is to break the bottle. When the key is turned, two pieces of metal push against a rubber section, making it expand against the neck of the bottle, wedging the stopper tightly in place. When the stopper is unlocked, the rubber contracts again.

Panama Hats Make Fine Footwear

MAKING shoes from Panama hats does not sound very practicable. But it has been done with surprising success. Managers of a large department store in New York City found themselves saddled with an overstock of Panama hats. They cudgeled their brains to figure out some way of disposing of them profitably. They finally found that Panama hats made attractive shoe tops, and accordingly turned them over to the shoemakers, with satisfactory results. The Panamas were cut for uppers bound with black velvet. The result was what might be called exceptionally "dressy." The picture shows a shoemaker turning Panamas into shoes, with a completed example.



Shoemakers' skill turned these hats into dainty shoes

Tombstone Warns Autoists

WHILE many tombstones are erected to commemorate some particular case of carelessness, the only one set up as a reminder of the combined result of neglect on human life, so far as can be learned, is one that stands at the center of the crossing of the principal streets of Middletown, a rolling-mill town of southern Ohio, to urge passing autoists to be careful.

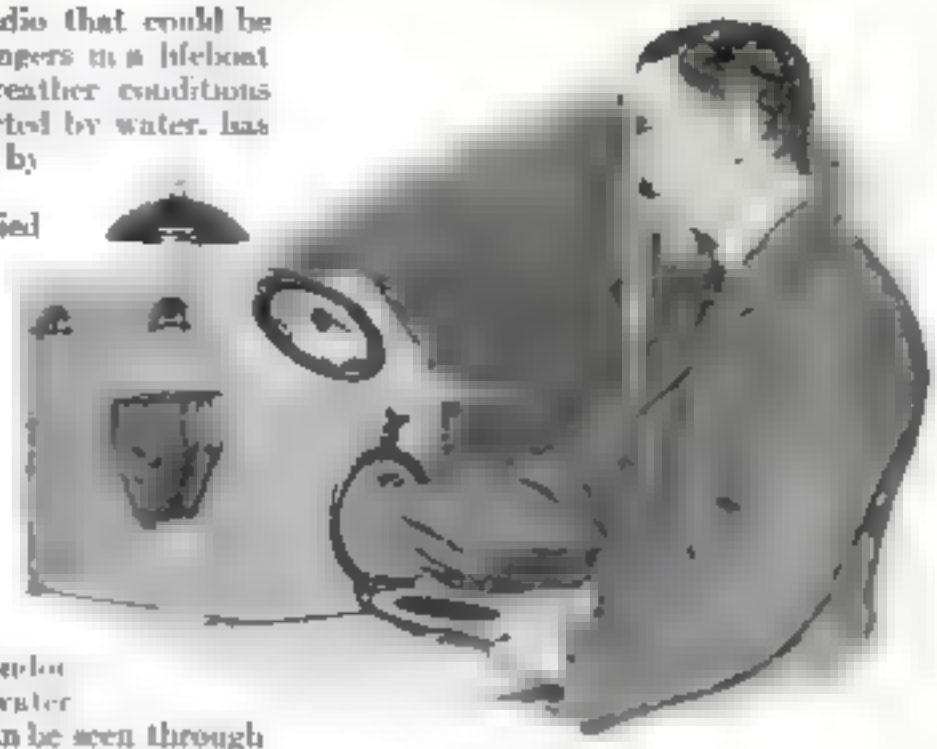
This warning monument bears a legend, in big letters, which reads, "In memory of life sacrificed on the altar of carelessness." On each of its sides there is recorded the number of automobile accidents, due to lack of care, in the last three years. The illustration above gives an idea of the impressive-ness of the warning. Many other cities are adopting similar attention-compelling means to reduce the dangers of their most hazardous street-crossings.

Invents a Waterproof Radio for Lifeboats

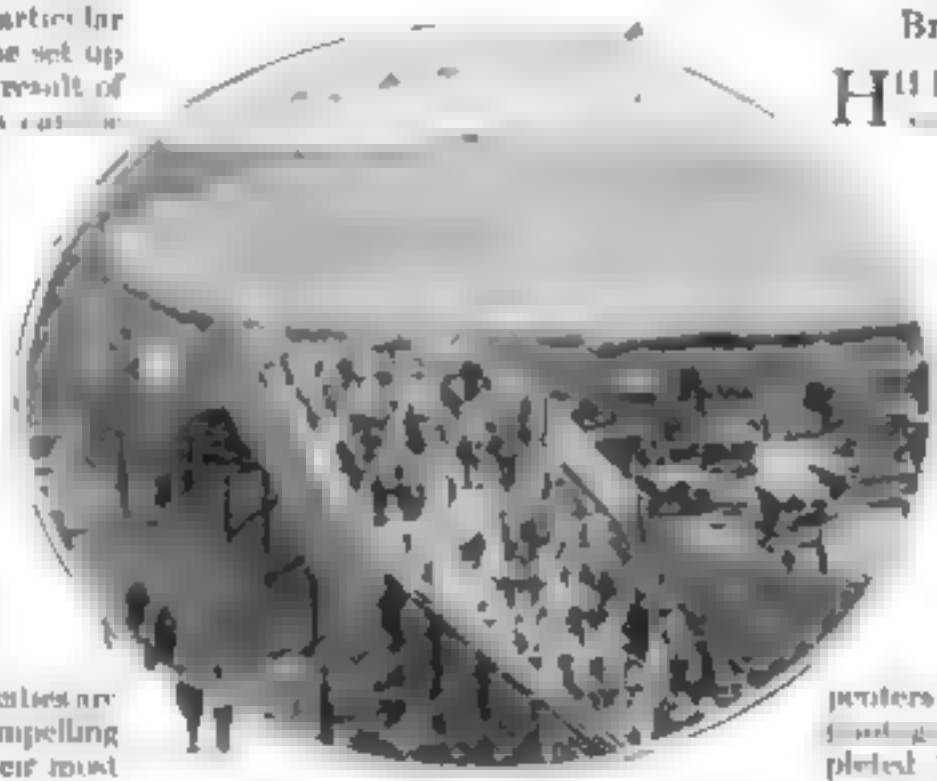
THE need of a radio that could be operated by passengers in a lifeboat under any kind of weather conditions and would not be affected by water, has long been recognized by marine experts.

Many sets were tried out, but had little success. The effect of the salt spray was seemingly impossible to overcome.

At last, however, an Englishman has solved the problem by inventing a waterproof set which was exhibited recently at a shipping and engineering exhibition in London. The set is enclosed in a water tight case. The dials can be seen through a sort of porthole, and are operated by one hand in a water tight glove and sleeve.



Enclosed in a moisture-proof case, this radio set resists spray



Cross-section of California "circus bridge"

Bridge Stops Traffic Jam

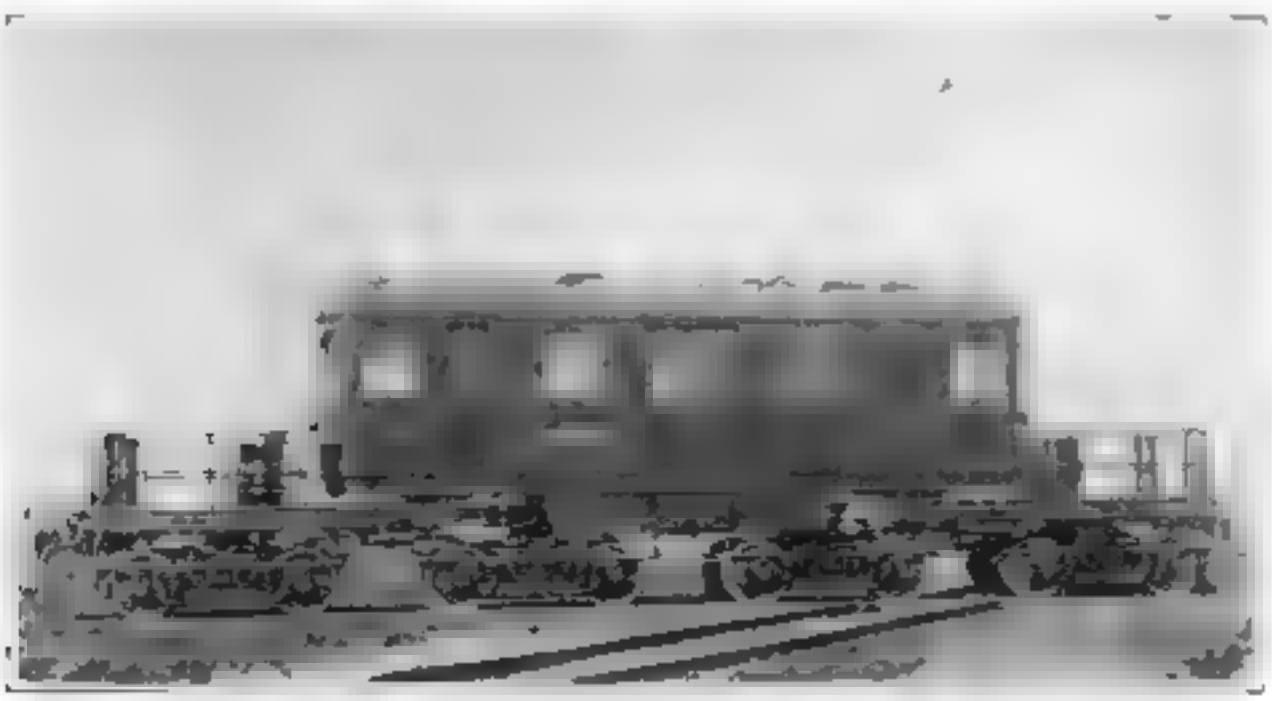
HILL STREET, Los Angeles, Calif., is crowded any day but on circus day the jam is terrific. So when the circus comes to town and hauls the big tent on one side of the street and the zoo on the other, the traffic problem is acute. How to allow the crowds freely to cross the street without tying up the traffic long puzzled the authorities. The street was too busy an artery of traffic to be closed.

At last a solution has been reached.

A temporary bridge is built over the street connecting the two tents, the speedy circus carpenters making a quick job of it. The photograph at the left shows the completed bridge, as it looks during circus week, packed with the circus-bound crowds.

A Four-Truck Engine for Sharp Curves

A NEW electric locomotive that can operate on short curves through cities is called an "articulated type." It has four trucks, to give ease in turning, the end ones turning independently of the others. The locomotive has eight motors connected to sixteen driving wheels, and develops 1000 horsepower



The odd-looking electric engine shown above is designed to negotiate the sharp turns in city traffic and has four independent trucks that allow it to take any short curve with ease

$10 for the Best Hint on How to Keep Cool

DO YOU know of a good way to keep cool in hot weather?

Most of us do not. For years we have tried palm leaves, electric fans, and cold baths, yet always we have found that these expedients offer at best only partial relief. Perhaps you have an ingenious way of keeping cool that you would be willing to share with others.

To the reader who submits the best practical hint on how to keep cool, POPULAR SCIENCE MONTHLY *will give a prize of $10. All other contributions found worthy of publication will be paid for at the rate of $1 each.*

Your entry must be in the offices of POPULAR SCIENCE MONTHLY *not later than April 30. Address the "Hot Weather Hints Contest" POPULAR SCIENCE MONTHLY 250 Fourth avenue, New York City.*

Novel Devices That

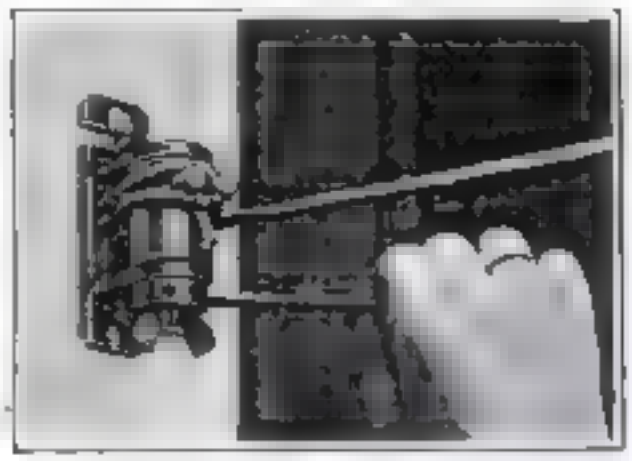
Ever-Increasing Number of Inventions

Baby No Bar to Housework

Taking a hint from the Indian squaw or the Japanese mother an American inventor has worked out a clever plan, so that baby can ride around on mother's back while she is at work. The baby is quite comfortable in a seat attached to a special harness, entirely concealed in the photograph by drapery. The seat is strapped to the shoulders, where any weight is least felt

Rack Allows Air Flow

Shoes are hung in order on the back of the closet door on a new shoe rack that has several unique features (below). It is adjustable to any width of door. It is open, so that wet shoes can dry out easily. And the rack is put in place with point screws that have sharp points like tacks and are driven in with a hammer until the thread catches very securely

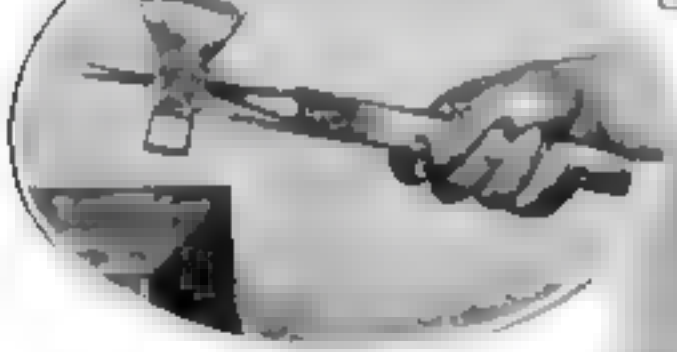


Device Tightens Clotheslines

A device that pulls a clothesline taut without the usual amount of pulling and straining will be welcomed by women, and men, too, who have to put up the line for the family wash. It does away with clothes poles, also. A ratchet mechanism pulls the line tight or loosens it as you choose. The tightener can be fastened to the house or to a post

This Coffee Has No Metallic Taste

Coffee made in glass in less than two minutes is the claim for this novel coffee filter. Water boiling in the lower bowl rises into the upper one. When heat is removed the water filters through coffee to the lower bowl



Handy Combination Tool

A handy household tool—suggested, it appears, by an Indian tomahawk—is this combination hatchet, hammer, nail puller, and box opener. It takes up little room and is always useful to the home worker, being four frequently-needed tools in one

A Wire Spout for Tumblers

A simple little wire clip, but when slipped over the edge of a glass (left) you can pour from it without spilling any of the liquid. It directs the flow of the liquid into a thin stream, filling even bottles easily

An Iron Squirrel Nutcracker

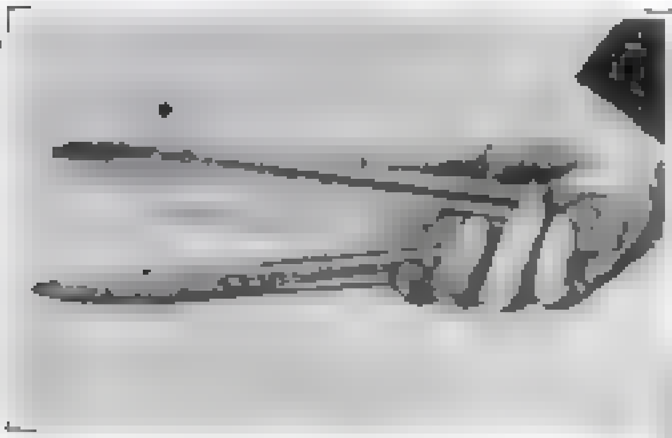
A novel nutcracker that is ornamental as well as useful comes in the form of a squirrel. Press the iron handle down and crack goes the nut. This powerful nut cracker is made of a good quality of iron. It is not easily broken, and will break the toughest nut. Its unique shape makes it an amusing table ornament to possess

New Rubber Spats for Autoists

To protect light-colored silk stockings from grease and dirt while driving a car, rubber spats, shown above, have been designed to fit on the back of the lower part of the leg. These can be neatly folded into a small waterproof bag, as seen in the picture at the left. They are also good for walkers

Cut Homemakers' Work

Makes for Greater Efficiency in the Home

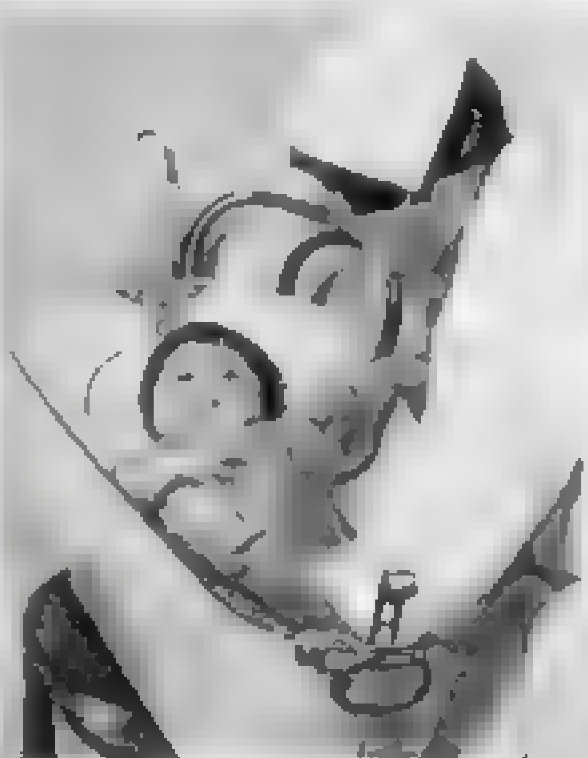


Tongs for Holding Hot Things

So many hot things have to be handled in the kitchen that tongs or lifters are always in demand. These kitchen tongs illustrated above are unusually strong and well made. They hold food for deep fat frying, soup cans for heating in hot water, or a dishcloth for bottle or jar washing. They may be used also to lift saucepans and earthenware

A Support for Baby's Bath

To make the baby's bath safe and prevent many a needless fright both for the child and the mother, a canvas support on a metal frame that fits the tub has been devised by health experts. It holds the child in the water just at the right height for bathing, as shown in the photo below so that it cannot slip to the bottom of the tub



Filtered Coffee with Ordinary Pot

Delicious filtered coffee can be made in an ordinary coffeepot with the addition of two perforated pans fitting into each other. Boiling water filters slowly through four tiny holes in the top pan through the coffee in the next pan to the pot below, when the beverage is ready to serve

Ingenious Apple Corer Saves Juice

A new apple corer that can be inserted to any depth, instead of going clear through, makes it possible to keep the bottom of the apple, so that it will hold sugar and juices, which, as the good cook knows, make the baked apple all the more delicious

Musical Cigarette Box

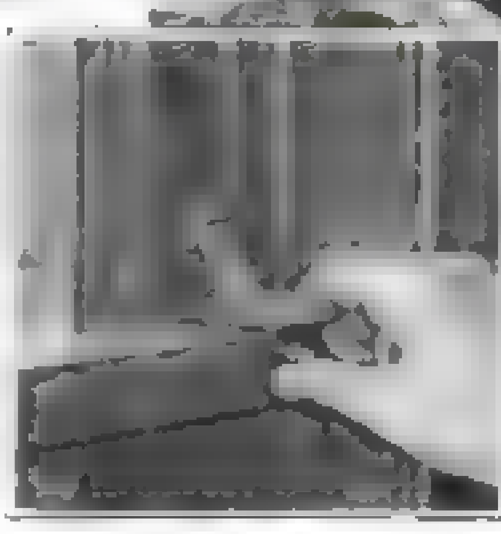
Raising the cover of this cleverly constructed cigarette holder releases a lever and starts a tune playing. The holder is a [illegible] It [illegible] tune ends by the tapping and dropping of the [illegible]

Keeps Vegetables from Breaking

[illegible]

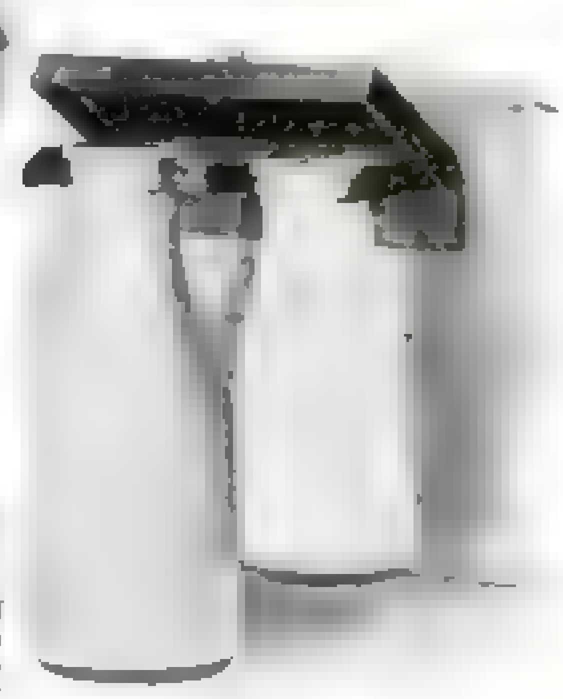
Handy Travel Iron

[illegible] women [illegible] place for [illegible]



A Burglar-Proof Catch

The burglar will pass up a window [illegible] by one of these new safety [illegible] the upper frame



To Stop Theft of Milk

[illegible]

Climbs Tallest Masts at 68

STILL spry enough at 68 to climb to the tops of the highest and shakiest masts to repair blocks and ropes, Henry Theodore, of Gloucester, Mass., above, is shown at work on the rigging of the *Columbia*, the fishing schooner that is to represent the United States in the international fishermen's race this year.

How Much Do YOU Know about Science?

THE well-informed person not only has knowledge of facts he also knows the reason for them. Have you a real understanding of the things that are happening all around you? Test your knowledge. Below are twelve questions dealing with everyday natural facts with which you are well acquainted. Can you give the proper explanation of them? Think out your own answer first, then turn to page 136 and compare it with the correct one.

1. Why does fog seem to rise up out of the ground?
2. What makes a bee hum?
3. Is there any scientific rule to determine how much a person should eat?
4. What is the difference between safety matches and the ordinary matches which will strike anywhere?
5. How is the perfume of a rose formed?
6. Why does starch make clothes stiff?
7. What is the planet Venus like?
8. Do the planets shine for the same reason that the stars do?
9. What causes cross-eyes?
10. Why does benzine take grease out of clothes?
11. What kind of rock is hardest?
12. Why do cut flowers wilt so quickly in a heated room?

Gunner Makes Fine Violins After Day's Work

A MASTER craftsman as well as a capable soldier and an expert shot is Gunnery Sergeant Emil J. Blade of the United States Marine Corps, who is employed during the day in making stocks for the rifles used by American marksmen who compete in championship shooting matches. But his hobby, to which he devotes most of his spare time, is making violins.

The Sergeant is also a champion marksman, and has won more than sixty medals. The picture at the right shows him looking over one of his violins, and wearing some of his medals.

Sergeant Blade looks over a violin he has just finished

Inventor with his new eyeglass lamp

Philadelphia Waiter Invents a New Surgeon's Lamp

A NEW type of electric lamp for surgeons and physicians which casts its light along the line of sight instead of at an angle to it, thus insuring, it is claimed, better vision, has been invented by Otto Wrappler, a head waiter of the Bellevue-Stratford Hotel, Philadelphia.

The lamp consists of a small bulb with a reflector which is attached to the nose-piece of a pair of glasses. It was favorably commented upon at a recent convention of physicians and surgeons at which it was demonstrated by its inventor.

Wrappler may be seen at the left with the new lamp adjusted to his glasses.

Girl Wins in "Board Boy" Contest

EMPLOYED for the last seven years as a "board boy" by an Atlantic City, N. J., firm of brokers, Miss Margaret Smith recently was the winner in a speed and accuracy contest conducted by her employers. Twenty-[illegible] participated in the tests. Miss Smith was the only girl.

[illegible] no allowance was made for differences of sex, but Miss Smith's experience and quick thinking brought a decisive victory, and she was awarded the title of best "board boy" in the firm. In the picture below, Miss Smith is shown posting the latest quotations of the stock and bond market as they are read to her from the ticker.

Girl [illegible] posting latest quotations of the stock and bond market on the blackboard

Only woman boxing glove manufacturer makes most of the mitts used in big ring bouts. Among her clients are counted many of the champions

Runs Boxing Glove Business

THOUGH not the only woman glove-maker in the country, Mrs. Sol Levinson, of San Francisco, is, according to reliable authority, the only woman engaged in the manufacture of boxing gloves. She took over the business about a year ago on the death of her husband, founder of the enterprise, and has succeeded not only in keeping it going, but in more than doubling its output.

Mrs. Levinson makes all kinds of boxing gloves, from the big padded ones for gymnasiums to the light mitts used in professional contests. Among her clients are the champions of the squared ring, from Jack Dempsey to the king of the flyweights. In the picture, Mrs. Levinson is seen with some fine samples of the gloves she has made.

Blind Scientist Invents Many Types of Lights

ONE of the most interesting men in Sweden is Dr. Gustav Dalen, scientist, whose world-famous lighthouse beacon won a Nobel prize. He is a sturdy man of middle age, light of heart, full of energy and enthusiasm, despite the fact that he is permanently blind and his face disfigured as the result of an explosion which occurred in his laboratory some years ago. His misfortune has not dampened his enthusiasm or slowed-up his work, in the slightest degree, and he gets around his workshop as readily as if his sight were perfect.

Dr. Dalen specializes in automatic lighting, and he has invented lights for signals on lighthouses and railroads, and for automobiles, motorboats, and airplanes. His crossroad traffic lamps are used extensively in London. He is seen in the illustration at the right demonstrating his most recent lighting invention.

Hatching Fish in Backyard Pays Well

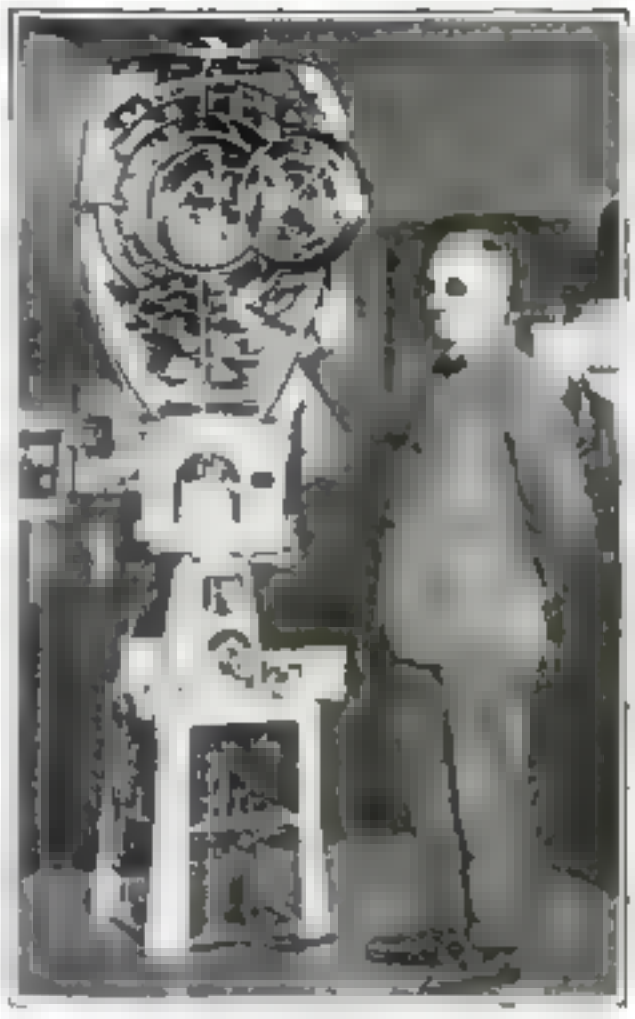
A UNIQUE business which pays handsome profits is carried on in his own backyard by Otto Gneidling, of Ridgefield, N. J., who raises fish—not the ordinary food kind, but prize specimens, that are used for breeding and exhibitions. His stock is kept in large tanks which are sometimes partly covered, but under certain conditions are left entirely open.

Gneidling's collection includes many of the rarest specimens, some of which are not only costly but very difficult to raise. Gneidling knows them all, their habits, their likes and aversions. Experience has shown him that fish thrive on fresh live food, so he raises all the food he feeds to his stock.

Gneidling has a surprisingly large stock of fish in his limited space, notwithstanding which he constantly adds new kinds.

In the beginning, Gneidling's idea did not seem very practical to many, but from the start it has been a paying business, and it is still growing. It fills a need that had hitherto been unfulfilled. In the picture at the left, Gneidling may be seen transferring some of his fish from a tank to a glass jar.

The net used by Otto Gneiding to catch the fish he raises when changing them from one tank to another or to glass jars



Breaks Auto Speed Record

THE world's twenty-four hour automobile record was recently broken by Captain John Duff, an Englishman, at Linas Montlhery, near Paris, it is reported, when he covered 2,205 miles in that time at an average speed of more than ninety-five miles an hour. At the left, Captain Duff is shown at the wheel.

Know Your Car

THE various types of corrugated treads molded on modern tires are a great help in preventing skidding, but when the streets are covered with greasy slime following a light fall of rain or sleet, or with heavy mud, there is no better way to prevent dangerous accidents than the use of tire chains. The place to carry tire chains is in the toolbox. The use of tire chains does not add to the life of your tires, but the extra wear they cause can be reduced by fitting them properly.

For maximum protection against smash-ups caused by skidding, follow these rules:

1. Pack your chains carefully and carry them in the car always.
2. Stop your car and apply the chains to the tires at the first sprinkle of rain. The worst skids often occur just then.
3. Use chains on both rear wheels. A chain on one wheel is of practically no use because the differential gear lets the other wheel slip.
4. Be sure to apply the chains loose enough so that they will creep around the tire. If they are too tight they will cut into the rubber.
5. Replace worn cross-links before they break.

Sphinx's Paws Cleared of the Sand of Ages

The Sphinx as it appeared after the last of the sand was removed

AFTER having been buried for ages in sand that reached far up its sides, the famous Sphinx of Egypt again stands out in its original form and beauty, as the result of extensive operations carried out by the Egyptian government to save it from entire destruction. Its gigantic paws, resting on a wide base, have been carefully brushed and are now no longer a subject of conjecture.

The removal of the sand required considerable time. To dig out the great feet alone took many days, because extra care was necessary. A high wall to protect it from future sandstorms will be built when the work of restoration is complete. Any sand that may be blown over this bulwark can be easily removed each year.

Workmen, whose stagings are seen in the illustration, are now engaged in restoring missing parts and strengthening weak spots. They are rushing to prevent a threatened fall of the head, the support of which has been weakened by the erosion of the back and sides of the neck. When that is done, they are to restore the Egyptian beard which once adorned it, and the headdress that fell off some time ago. The engineers hope to complete the undertaking in less than a year.

A TRAFFIC SIGNAL light that is worn on the finger like a ring has been devised by a Hollywood, Calif., inventor, who recently received a United States patent on it. It is intended for policemen directing traffic.

Soldier Builds Mosque Home

Percy Stamwitz, of England, giving the final touches to his mosque-like home

WHEN during the war Percy Stamwitz of Sunbury-on-Thames, England, was serving as an officer in the Holy Land, he developed a great liking for Mohammedan mosques, and resolved that some day he would build a house modeled after them. About two and a half years ago, he and his seventeen-year-old son started work on it, and now it is practically finished.

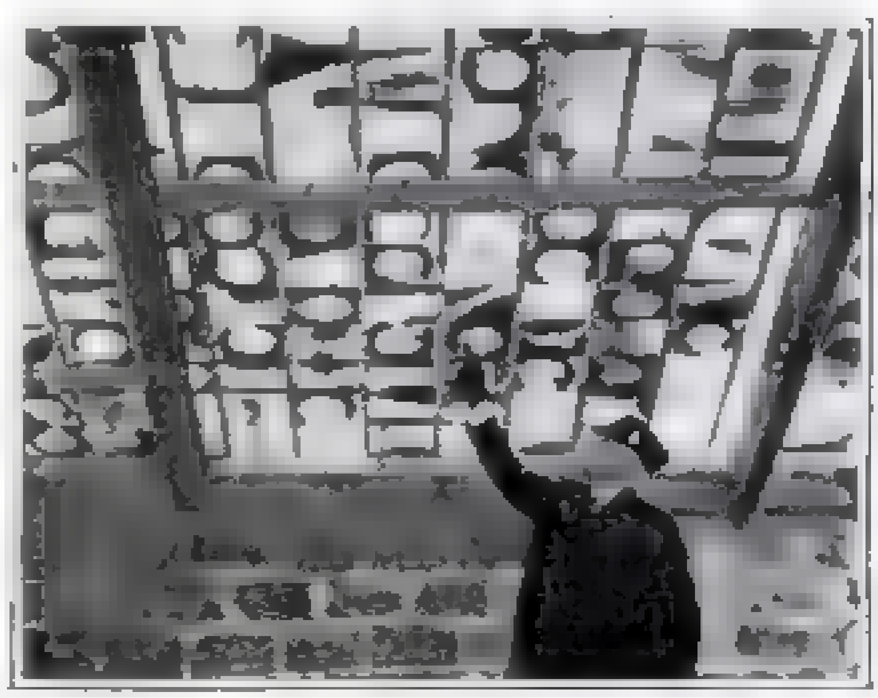
Cement Workers Who Wear Gas Masks

GAS masks are worn by workmen laying a tennis court in Hollywood, Calif., on account of a deadly poisonous gas developed by the chemicals employed in the special patented process of cement work they are applying. But even wearing masks, they can work only in short shifts of not longer than twenty minutes at a time. The cement for this process can be laid only at night, by artificial light.

Old X-Ray Plates Make Weird Roof

IN THE shadows of human skulls, lettuce is growing, while radishes sprout in light filtered through photographs of various parts of the body, in a greenhouse on Deer Island, Boston's prison island. A "chamber of horrors," the jail inmates call it.

When the house was built, no glass was available, so old X-ray negatives obtained from a Boston hospital were used as window panes.



Winners of Grand Prizes in Our $10,000 Contest

The Judges Announce Cash Awards to 308 Contestants

YOU MEN who pride yourselves on your skill with tools and who boast of your knowledge and mastery of all the little odd jobs about the house, take your hats off now to the handy-woman supreme

To Miss Louise Gardiner Walshe, of Jersey City, N. J., goes the distinction of winning the highest award—First Grand Prize of $2,500 cash in POPULAR SCIENCE MONTHLY'S great $10,000 "What's Wrong" picture contest, which began in our June, 1925 issue. From many thousands of clever contestants—among them skilful mechanics and engineers—Miss Walshe was selected by the judges as having submitted the best set of answers to all thirty-two pictures depicting the adventures and mistakes of John and Mary Newlywed as they faced the complicated problem of homemaking

The complete list of the 308 winners of $10,000 in grand prizes appears on page 139. This list, and photographs of leading prize winners which appear on these pages, will give you some idea of the tremendous interest which our remarkable

Woman Wins First Grand Prize of $2,500

TO MISS LOUISE GARDINER WALSHE of Jersey City N. J., goes the highest award in our $10,000 "What's Wrong" contest. She made a perfect score for the thirty-two pictures showing the adventures and mistakes of John and Mary Newlywed In her girlhood Miss Walshe learned how to use tools. And now, in the home where she keeps house for her father, she has a completely equipped tool chest and does all the odd repair jobs about the place. This photograph shows her at her drawing-board, as she worked on the contest, which won for her over $3,000 in cash

$10,000 contest aroused, and of its wide appeal to men and women in all parts of the country and in many walks of life. You will find that among the prize winners some are teachers, others are men skilled in the use of tools, still others are men with office jobs who, from the experiences of John and Mary, learned for the first time how to avoid mistakes in doing odd jobs with their hands

Perhaps the most surprising feature of the contest was the keen interest shown by women. Their success in "spotting" the pitfalls into which John and Mary fell and in correcting their errors, was truly amazing.

Miss Walshe, of course is the striking example. Not only has she won the First Grand Prize of $2,500, but she also won a first prize of $500 and a second prize of $100 in the monthly contests. In the kitchen of her home in Jersey City, Miss Walshe has a completely equipped tool chest filled with tools which she knows how to handle expertly For years she has done all of the odd jobs around the house Many of the problems of John and Mary she herself had experienced a fact which no doubt accounts partly for her record of a perfect score throughout the four months of the $10,000 contest.

In a quiet, residential section of Jersey City, Miss Walshe (Continued on page 139)

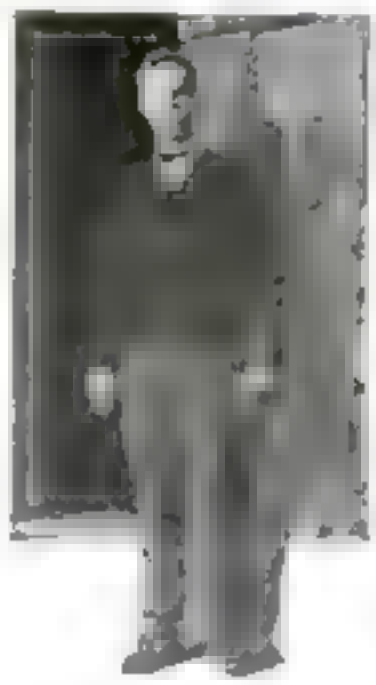
Milton A. Graves

Death Stole Second Prize of $1,000 from Winner

CRIPPLED since boyhood and lying on his sick-bed, Milton A. Graves, of Evanston, Ill., entertained himself through the long summer days by working on the problems of John and Mary. The task completed, the fates ruled that he was not to enjoy the rewards, for death came only a few days after the $10,000 contest was closed. His estate will receive the prize won by him. His mother lives in San Luis Obispo, Calif.

$500 Prize Helps Youth through College

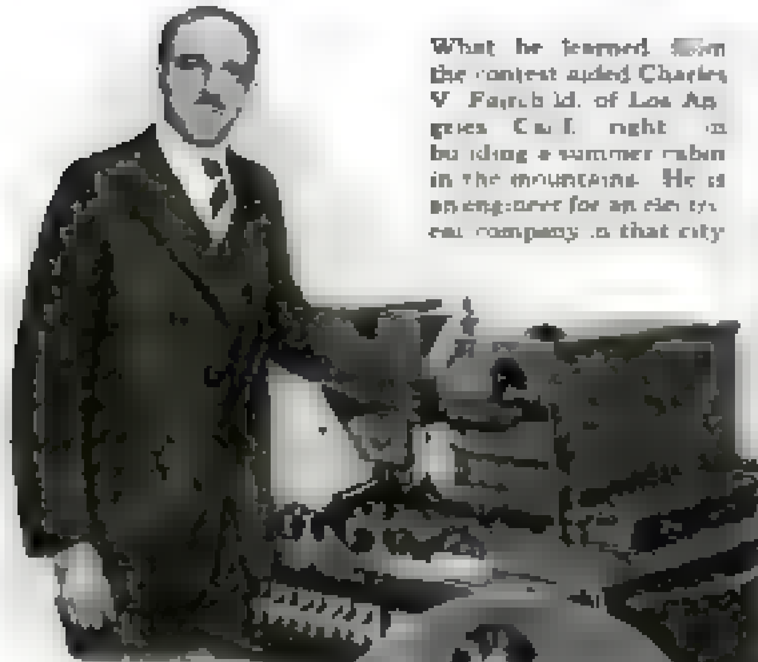
WORKING his way through college, John C. Elder, of Somerville, N. J., spent his spare moments during the summer working on the $10,000 contest. He hoped, he says, not only to gain experience through studying others' errors, but also to win one of the cash awards that would help pay for his education. That he succeeded admirably in both aims is evidenced by the fact that the judges awarded him the Third Grand Prize of $500



John C. Elder

FOR THE COMPLETE LIST OF 308 GRAND PRIZE WINNERS, TURN TO PAGE 139.

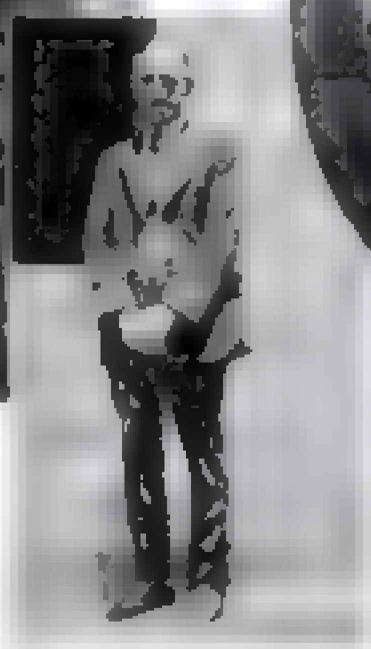
The Five Winners of the $50 Grand Prizes



In his home, in Baltimore, Md., G. A. Graham had tackled many of John's and Mary's problems, and this experience helped him win a grand prize. He is an electrical engineer of the United States Army Signal Corps

What he learned from the contest aided Charles V. Fairchild, of Los Angeles, Calif. (right), in building a summer cabin in the mountains. He is an engineer for an electrical company in that city

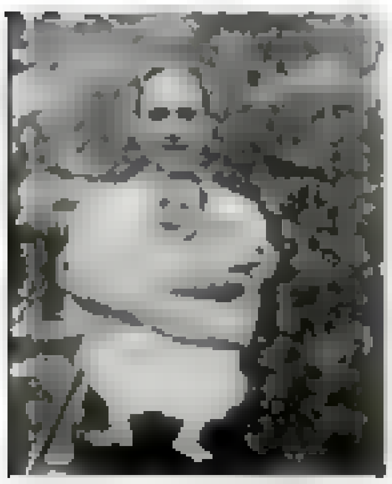
Mrs. Theresa Solomon of New York City (left) found recreation from household tasks in working on the $10,000 contest. She was ably assisted by her husband and daughter



Mrs. H. B. Walker, New Orleans, La., and her sixteen-months-old son Hal. With her youngster she enjoyed working on the contest

An all-round handyman, [illegible] of Washington, D. C. (left), made good use of his knowledge in the picture contest. He is employed by the United States Bureau of Standards at Washington

Introducing Some of the $10 Prize Winners



E. H. Hutton, traveling salesman and bachelor, of Hackensack, N. J. He "borrowed the baby to lend a human touch" to the picture

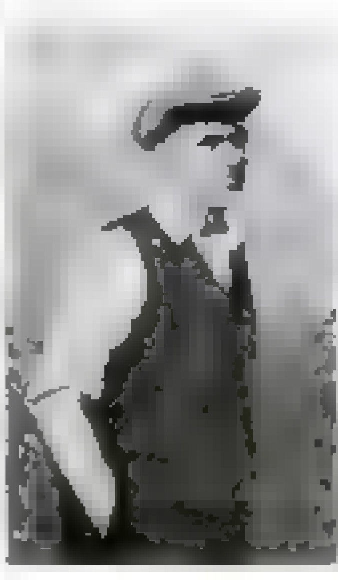
At right, A. J. Fisher, machinist and engineer. He resides in Royal Oak, Mich.

Glen D. Fleak, machinist, of Beaumont, Tex., at his radio set. He has tackled all the odd jobs that troubled John and Mary. Radio is his hobby

Lester E. Tookey, of Denver, Colo. He found the $10,000 contest very interesting and a "most absorbing pastime"

At left, R. W. Kennedy, of Peckville, Pa. "Making things" has been his hobby

Miss Frances Evelyn Jones, of Coronado, Calif. (left, above). In her letter, she says that she is now taking a much keener interest in tinkering with her own car since entering the contest



A mechanic by trade, George D. Hugo, of Seattle, Wash., tells us that he also is "a handyman (by good nature) for the neighbors." He enjoyed the contest

Lieutenant-Commander Paul M. Bates, U. S. N. He is general inspector of naval aircraft for the Central District, and is stationed at McCook Field, Dayton, Ohio

Albert L. Snedaker, Mount Ephraim, N. J. In his suburban home he says he has had plenty of opportunity to try his hand at odd jobs just like John's

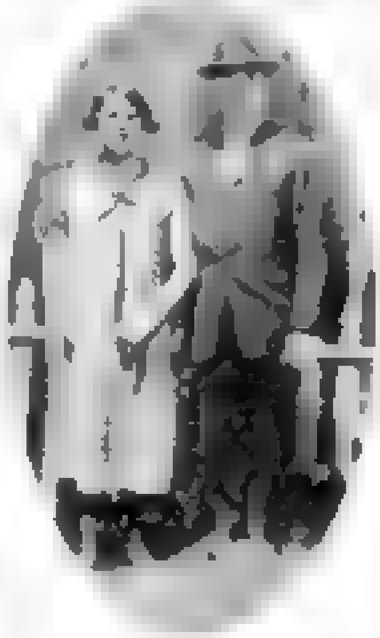
Charles Karlberg, of Cleveland, O., is pictured above with his two children. Much of the credit for finding errors in the contest pictures he gives to Mrs. Karlberg

F. P. Hodgkinson, engineer of New York City, says he has "profited immensely by this contest"

Howard H. Sweet, manufacturer of Attleboro, Mass., with his wife and seven-year-old daughter. He attributes his success to intelligent application of "common sense"

James C. Lamb, consulting engineer, of Warsaw, Va., served as engineer in France

Edward C. Boesler, of Helena, Mont. (left), works in a grocery store to pay for his tuition at college. He is taking up electrical engineering



To find John's mistake, Helen Howard, of San Diego, Calif. (right), took one of her electric flat irons apart

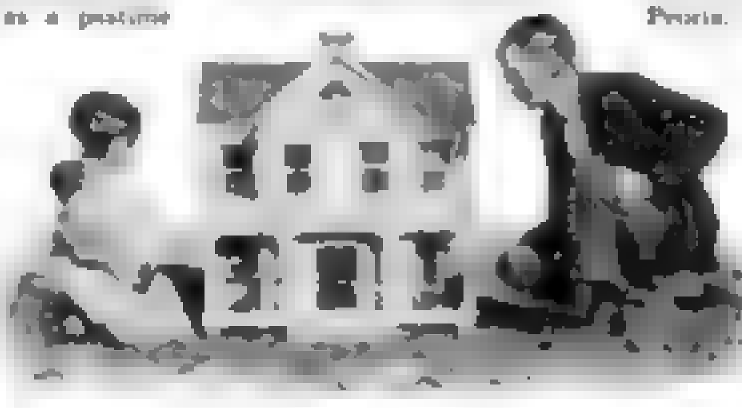
L. O. Hammond, plumber of Columbus, O., invents and makes models as a pastime

Robert E. Hester, custodian in Oakland, Calif., public schools. He is also an all-round mechanic

William T. Weld, instructor of shop work in the Peoria, Ill., High School

Harrison MacGregor, of Springfield, Mass., is a member of ... in the United States Army

P. W. Rushforth, of Hanover, N. H. A fine home workshop is his pet hobby



In his leisure hours A. Hamilton King, a farmer of Waverly, Va., made the above toy house in his workshop

An "embryo writer," Miss Ruthe ford D. Holdredge of Los Angeles, Calif., says her success in the contest has encouraged her in her ambitions

"I was working on an invention when the contest opened but I couldn't let the chance go by," writes Charles Hausteing of St. Louis, Mo. Technical illustrating is his vocation

K. L. Barrett, of Fort Myers, Fla. (left), is a real estate operator with a mechanical turn of mind"

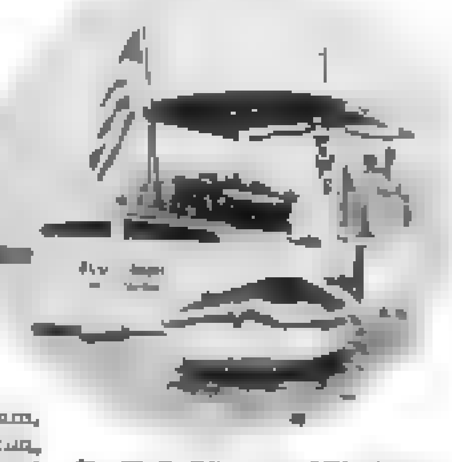
Gordon B. Moss (right) is a commercial artist of Indianapolis, Ind. He and Mrs. Moss had a lot of fun working on the contest

"Two representatives" of George B. Cox. He is one of the assistant professors in the University of Wisconsin

Ernest H. Dale, of Philadelphia, Pa., certified public accountant, did his contest work in odd moments

A cripple most of his life, Lloyd Phelps, age 19, a resident [illegible] Calif., is a good mechanic and quickly spotted John's and Mary's mistakes

Com. W. D. Greetham, of South Charleston, W. Va., is a retired naval officer. He has served his country a third of a century



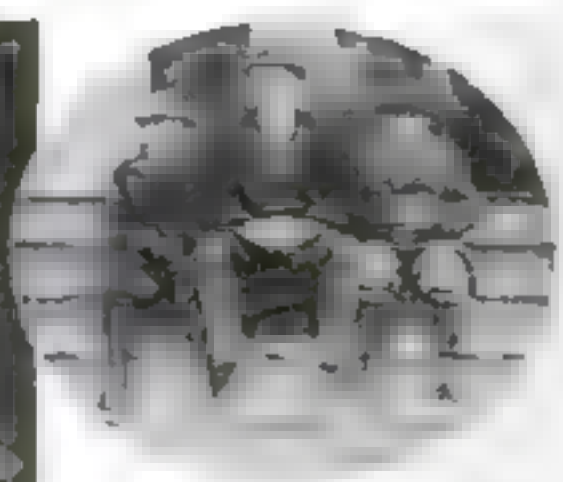
Dr. R. B. Clinton, of Washington, D. C., enjoying a cruise down the Potomac river in his comfortable boat, the *Bluebird*

More of Our Readers Who Share in the Prizes

A. E. Livingston, assistant professor of pharmacology in the University of Pennsylvania, says that he found the contest "a delightful diversion"

Leslie Nuhl, of St. Louis, Mo. His specialty is testing and repairing calculating machines

R. L. Nichols, of Fairmont, W. Va., a registered nurse and student in accountancy



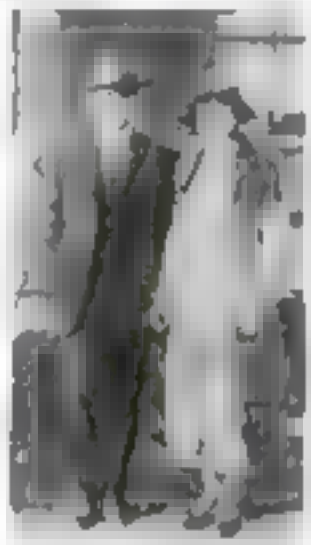
These two boys helped their father, J. W. White, of Scranton, Pa., win a prize in the contest. In fact the whole family joined in the fun

H. T. Shrum, of Oshkosh, Wis., instructor of auto mechanics, thought the contest good practice

Laura Pullen, of Bandon, Ore. It was her first contest and she won

This attractive ship model is just one of the many things that L. B. Hendershot, of West Hartford, Conn., has made in his home workshop

"A contest for me is what a red rag is to a bull," says Mrs. Nina E. M. Leonard, of Houston, Texas

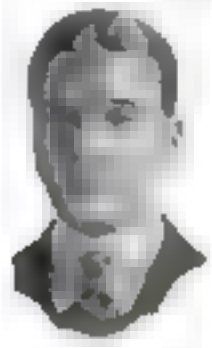


Mrs. M. F. Bell, of Carbondale, Pa., and bride. They solved the contest on their honeymoon

J. H. Glasser, of Cleveland, O., a commercial artist whose hobbies are puzzle contests and radio

When John M. Lucero, of Los Angeles, Calif., is not selling real estate, he likes to tinker around the house. His family helped him win a prize

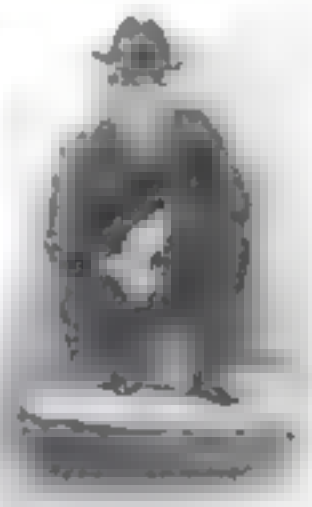
C. L. Isley, Jr., assistant superintendent of health in Memphis, Tenn., and Mrs. Isley are working toward a home of their own



Edwin T. Brown, of Pittsburgh, Pa., is an ambitious bookkeeper. The contest he says, taught him new short cuts in doing all sorts of odd jobs

Mrs. P. H. Crago, Wilkinsburg, Pa., helped amuse a sick husband by working on the contest

B. E. Moore, draftsman, of Los Angeles. He says the "boys" checked his answers



W. C. Nicol, of Pittsburgh, Pa. All the members of his family enjoyed the contest with him

Life Saving Ideas to Reduce Toll of the Seas

A SAFETY chamber to enable a crew of a sunken submarine to rise to the surface has been invented by Congressman Anthony J. Griffin, of New York City. The loss of 349 lives in six submarines, in a year, according to Congressman Griffin, demands immediate action, and he has offered his device to the United States Navy.

The invention consists of a series of buoyant safety chambers, placed between the submarine's hull and superstructure, which may be entered from below. Each chamber will accommodate fifteen men. There is an apparatus in the chamber that sets it free from the submarine, allowing it to float to the surface. The device is said to work even when the sunken boat is flooded by the rushing water following a crash.

Congressman Griffin looks over plans of his new submarine safety chamber designed to allow crews to get out when boats are sunk by accident

This Boat Has Rails on Keel

A NEW improvement on unsinkable lifeboats which promises to be of greatest value in ocean accidents has been invented by an Englishman, Captain F. F. Lowndes, above. As lifeboats are now constructed, there is small chance of a passenger's holding on or righting it, if by any chance it overturns, and many lives are consequently lost.

Captain Lowndes' invention is intended to remedy this by providing two long easily grasped handrails, which are attached to the keel, and two boards jutting out from the sides of the boat. These make it possible, it is said, not only to hold on, but also to right the boat without great trouble. Tests recently made in a British harbor before a gathering of marine experts are said to have confirmed all its inventor claims for it.

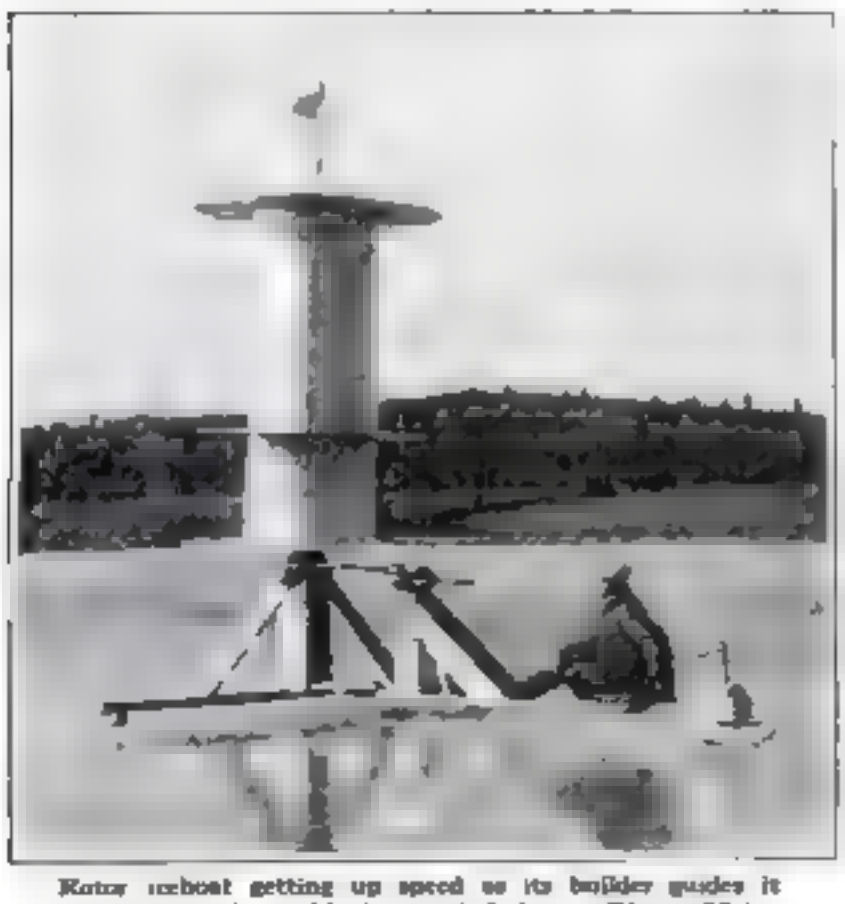
Automatically Rights Itself

SAFETY features of another new lifeboat are that it automatically bails itself, rights itself when overturned, and will not capsize under the most trying conditions. Its inventor is R. A. Dobson, a Boston navigator, whom the illustration above shows holding a model of the boat.

The new boat is really two boats, one fitted inside the other and securely fastened to it by means of a sliding arrangement. Both boats are made up of watertight compartments which are constructed of cork and copper tubing. The outside covering is canvas.

The boat is built to withstand the force of the biggest waves and the hard pounding on the rocks. A 20-foot boat of this type will carry sixty persons without crowding. The idea is said to have been tested successfully.

Rotor Runs Maine Man's Rowboat and Iceboat



Rotor iceboat getting up speed as its builder guides it over the smooth ice of Androscoggin Lake near Wayne, Maine

LIVING in vacation land in Maine, Carlisle A. Lincoln took more than passing interest in Flettner's rotor ship, which received such widespread publicity last year. After studying it in detail, he decided the rotor idea could be used for sports, with some adaptations.

Recently he built a pleasure-boat, seen in the picture at the right, and this winter he made an iceboat, shown in action at the left, and equipped both of them with rotors. He has sailed them successfully on Androscoggin Lake, near his home town of Wayne.

The pictures show that his rotor has an extra flange about one third of the way from the base of the rotating cylinder.

The builder poses on the side of his craft before leaving for a sail on the famous lake

The two condensers at the left are obsolete and inefficient but there is little to choose among the other four for electrical results. The third and fourth with a special dial give straight line tuning, while the fifth and sixth will give the same results with a plain dial

Novel Condensers Aid Tuning

New Straight Line Types Separate Stations on Dials

By Alfred P. Lane

TUNING a sensitive and selective radio set is a ticklish proposition when you try to find the stations that usually come in below thirty degrees on the dials. And the farther down you go on the wavelength band, the harder it is to log stations, because they are apparently separated by a mere hair-line change on the dials.

The reason for the congestion of stations on the lower part of the dial lies in the method used by the United States Government in figuring out the wavelengths so that there will be as little interference as possible between stations. They have found that it is possible to have stations with only ten kilocycles between them and still have no serious trouble. But wavelengths and kilocycles do not go hand in hand. At the lower end of the broadcasting band, ten kilocycles do not change the wavelength nearly as much as the same change does at 500 meters, for instance.

RADIO engineers have now solved this congestion problem in two novel and ingenious ways. While the methods are totally different, the net result to the radio fan is exactly the same—you can now change your receiver to space all the broadcasting stations so that the same number of divisions on your dials will separate each station from the next one all the way from one end of the dial to the other.

One method by which this amazing result has been accomplished is in the development of what is known as the straight line frequency condenser. And the new condensers of this type now on the market are remarkable examples of electrical efficiency as well. The illustration at the top of this page shows the progress that has been made in the design of radio condensers.

At the left of this group is one of the first forms of condenser in which the plates rotated. Electrically it was not to be compared with the present-day types. The next step was to make the end pieces triangular in shape, and shortly after that the full circular end plate condenser made its appearance. When properly constructed, a condenser of this type is efficient, but the metal end plate types were demanded by the radio fan, and they are now used everywhere.

The two condensers at the right are good examples of modern straight line frequency types. Note the peculiar shape of the plates of these two condensers. As the shaft is turned, the plates engage with each other more and more rapidly. The result of this construction is to give slow changes in capacity when the plates are nearly disengaged, and rapid changes when the dial is turned to the higher numbers.

The amount of capacity in the electrical circuit is the variable factor in most modern tuning circuits. What this actually means to you is that, if you have the new straight line frequency condensers in your set, you can turn the dial much more between stations on the lower numbers than you could with one of the older types of condensers made with plates cut like half moons.

Straight line frequency condensers can be substituted for the condensers in your present set. The only limiting factor is the question of space. If you want to bring your old set up to date all you need to do is to examine your set carefully and measure the possible clearance around the condensers you now have. Then go to your dealer armed with these figures and he will be glad to help you pick out new condensers that will fit into the space available.

New Condensers Well Made

Early difficulties with loose, wobbly shafts, poor connections and changing capacity are eliminated

But there is another way to accomplish the same result, and you can do it without discarding any of the apparatus now in your set. Look on the following page at the pictures of two styles of dials that can be attached to any ordinary type of condenser shaft. In other words, you can put them right on your own set in place of the dials you now have, and you will get exactly the same results obtainable with straight line frequency condensers.

THE pictures at the top of the page opposite also show the back view of these two varieties of dials. These views will give you a clear idea of how they work. At the bottom is a dial that produces the straight line frequency effect by means of a cam action. As the dial revolves, the cam arm which is fastened to the shaft of the condenser moves nearer and nearer to the center. This means that as you turn the dial toward zero, the condenser plates move slower and slower in proportion to the amount of motion of the dial. What it really amounts to is a vernier action at the lower end of the dial combined with a faster motion at the upper end of the scale where the stations are apparently better spaced.

The dial shown at the top, in the same illustration accomplishes approximately the same result by the use of eccentric gears so placed on their shafts that the slow motion of the condenser shaft comes where it is needed most.

Many radio fans have somehow gained the impression that a straight line frequency condenser is a sort of magical piece of apparatus that will enable them to tune in stations they never heard before. This idea is without foundation in fact. A straight line frequency condenser can not possibly bring in any station that could not be tuned in with a condenser having the ordinary half-moon-shaped plates. But the new condensers are a real advantage in that they make tuning much easier. Or you can get the desired results

with the special dials available.

The fitting of the new straight line frequency condensers to your set is a simple job—much easier than it appears at first glance. Assuming that you have purchased the new condensers and that they will fit in the space and are of the same maximum capacity as the ones now in your set, the first step is to disconnect all the batteries and remove all the tubes. Then take some small price tags and tie one to each of the wires that now are connected to the rotary and stationary plates of the condensers in your set. Mark with a pencil on each tag the name of the terminal to which the wire is attached.

You may find that one wire is attached to each end of the stationary plates of one or more of the condensers. If the new straight line frequency condensers you have purchased are of approximately the same general shape as those now in your set, it will be desirable to wire the new ones in the same way. On the other hand you may find that the new condensers are built in such a way that there is only one support and consequently only one terminal for the stationary plates. By referring to the two right-hand condensers pictured at the top of the page opposite, you will understand this point. Note that the one at the extreme right has a long set of stationary plates with a terminal at each end while the one next to it is built with the stationary plates supported at the center with just one terminal.

AFTER you have carefully marked all of the wires, disconnect them and proceed with the removal of the condensers by taking off the dials with a screwdriver and then take out the supporting screws. Be careful in lifting the condensers out of the set to disturb the wiring as little as possible.

You will probably find that the new instruments are of the single hole mounting type—most modern condensers are built in this way. All you have to do is to place the new condensers with the shafts through the holes and tighten up the nut. Then reconnect the wires according to the markings on the price tags. If there is only one stationary plate terminal, connect to it both wires which were connected to the two terminals of the old condensers.

Make sure that the other wires in the receiver do not touch the framework of the instruments at any point. This is most important. And you want to be sure that the rotary plates have an unobstructed path so that you can turn them to the completely disengaged position without encountering any wires.

You may find that the shaft holes through the panel are just large enough to allow the shafts to operate without rubbing against the sides of the holes. If that is the case, you will be unable to push the threaded portion of the new condensers through the hole until you drill it out. The drilling can be done with an ordinary twist drill of the proper size—usually one-half inch. But many radio fans do not possess a hand drill that will take such a large size drill, so you may find it necessary to use a taper reamer to get the holes large enough. Your hardware dealer carries a standard size of taper reamer that will ream a hole as small as one-eighth inch up to one-half inch. Such a reamer is not expensive, and if you have no bit brace in which to clamp it, you can turn it on the hole with a pair of pliers, although the job will naturally take a trifle longer.

If, instead of fitting straight line frequency condensers, you decide to get the same results by adding dials that convert your present condensers, you will have to follow the directions packed in the cartons. Each type of dial requires different treatment, of course.

When you have the new condensers or dials fitted, you will probably be all at sea when you start to tune-in stations. The figures in your old log book will not help you because all the stations will come in at different settings of the dials. KDKA, for instance, which you formerly found at somewhere in the neighborhood of twenty-five or thirty degrees, with straight line frequency tuning should come in at slightly more than halfway around the dial.

In fact, all of the stations will be received at a higher point on the dial except those near the top of the wave band, such as KYW and KSD. The latter will probably be found within a degree or two of its setting with your former arrangement.

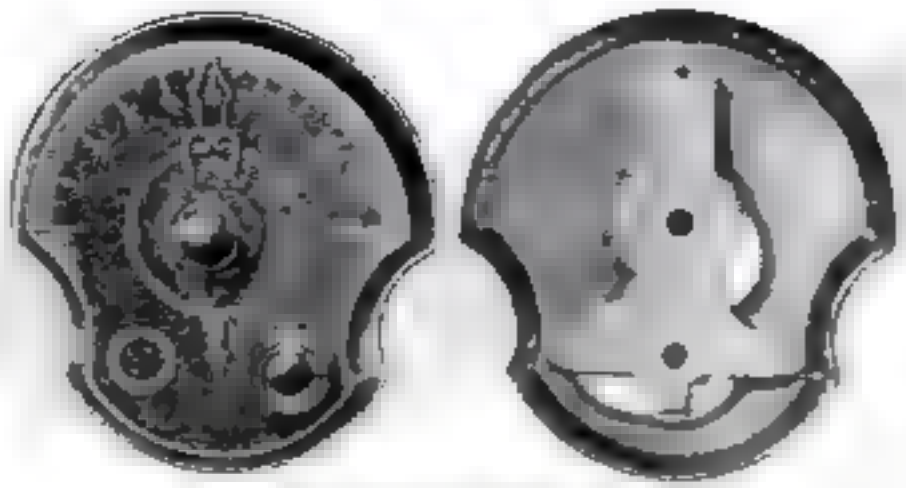
You will find that all of the high wave stations are much nearer together on the dial. While this may be considered by some as a disadvantage, it is amply compensated for by the ease with which you can log all of the stations at the lower end of the dial.

The radio laboratory of the Popular Science Institute of Standards has tested and approved a number of the new straight line frequency condensers and dials. The list of approved apparatus will be sent to those of our readers who request it.

You will have to decide for yourself, of course, as to whether it is best in your own case to fit the new style straight line frequency condensers or to fit special dials to the shafts of the condensers now in your radio set. Whether you choose the new style condenser, or the special dials for your present condensers, either procedure will accomplish the same result as far as tuning is concerned.

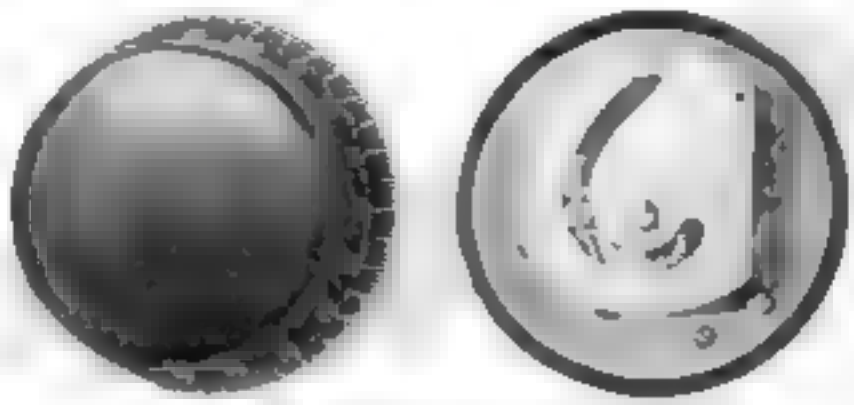
YOU have the same decision to make if you are building a new set. There is one point to bear in mind in buying the new style straight line frequency condensers, and that point is to forget your old notions about the number of plates being the controlling factor in the capacity rating of a condenser. With the half moon type of condenser, a 23-plate instrument usually has a maximum capacity in the neighborhood of .0005 microfarads, but the straight line frequency types may have twice or only half this number of plates.

Be sure, therefore, that you check up the maximum capacity rating of the condenser by the label on the box. All good condensers are now rated in terms of capacity rather than the number of plates.



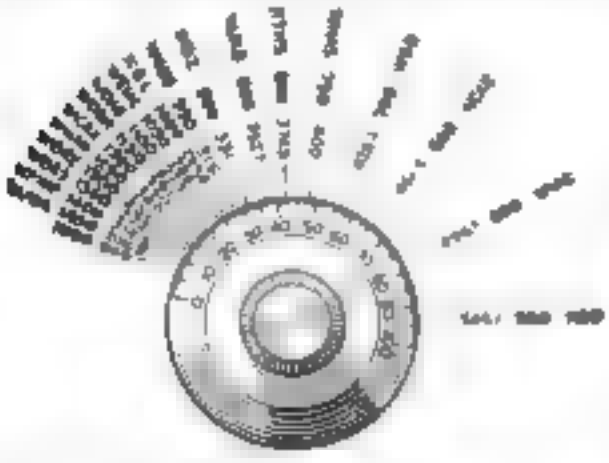
This Dial Uses Special Gears

Attached to the shaft connected with the knob on the front of this dial is an egg-shaped gear which engages with a similar gear that is clamped to the shaft of the condenser and gives approximately the effect of straight line frequency tuning to the pointer

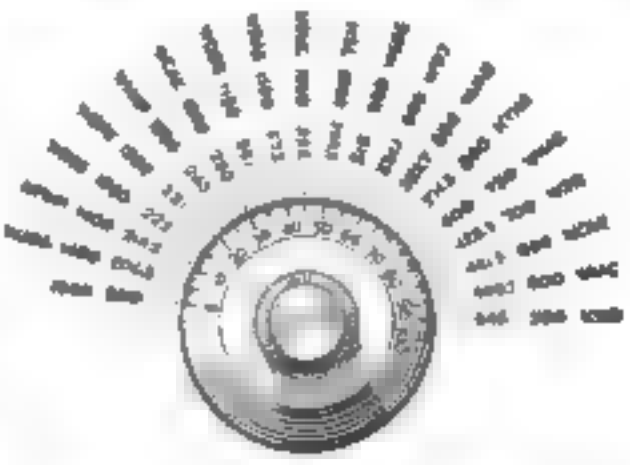


Cam Arrangement Operates This Dial

True straight line frequency tuning is obtained with this dial by the use of a cam that slides in a groove cut in a spiral. The dial rotates through a full circle. This feature makes logging much easier

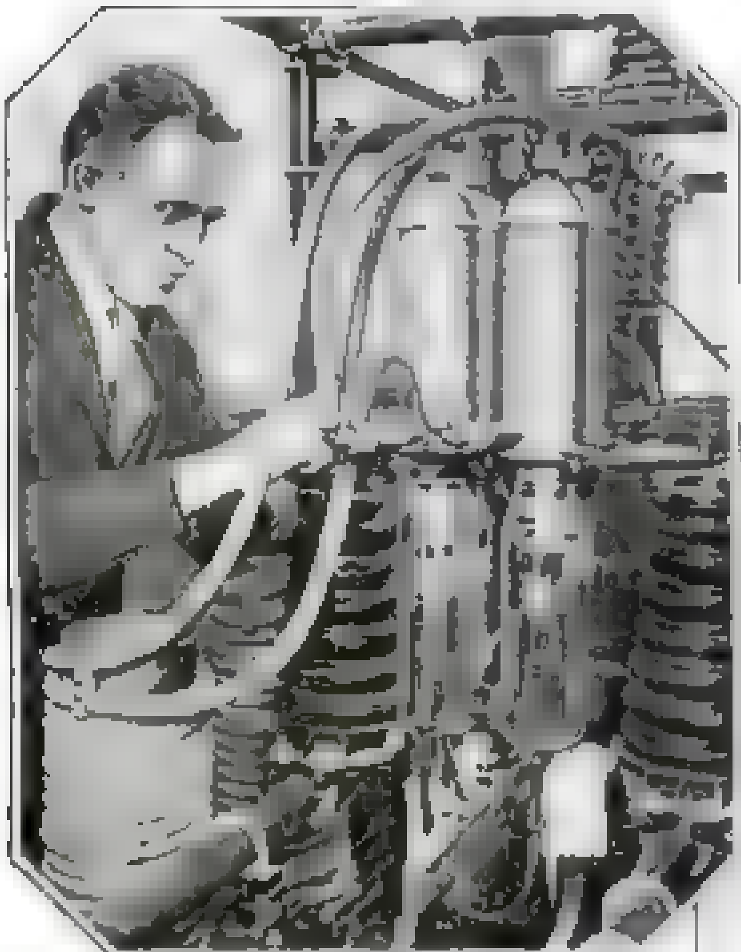


Because stations are separated by ten kilocycles, they are jammed at the lower end of the dial



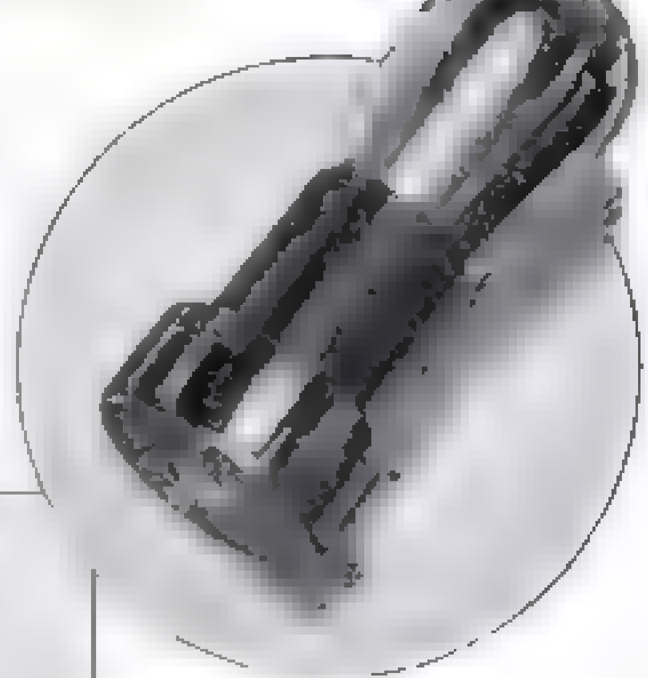
If your set is fitted with either of the new condensers, tuning will be comparatively easy

Recent Advances in Radio



A Giant Tube Cooler

After the water has cooled the powerful new tubes of the new superpower station at Bound Brook, N. J., as shown at the left, it is passed through a cooler so that it can be used over again. Below is the huge water cooler used for this purpose, which will cool 100 gallons of water a minute

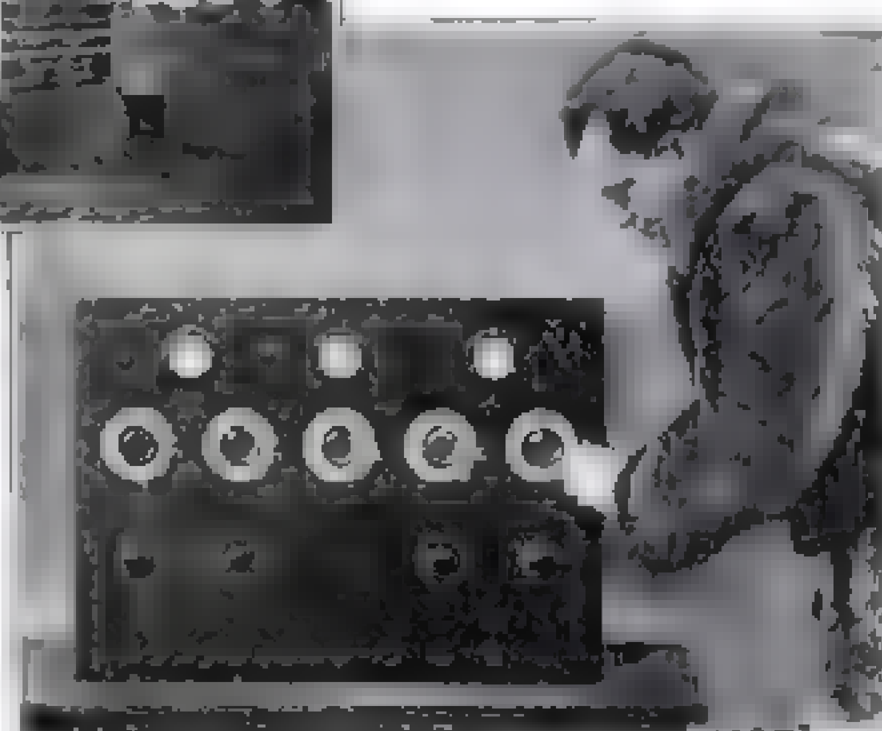


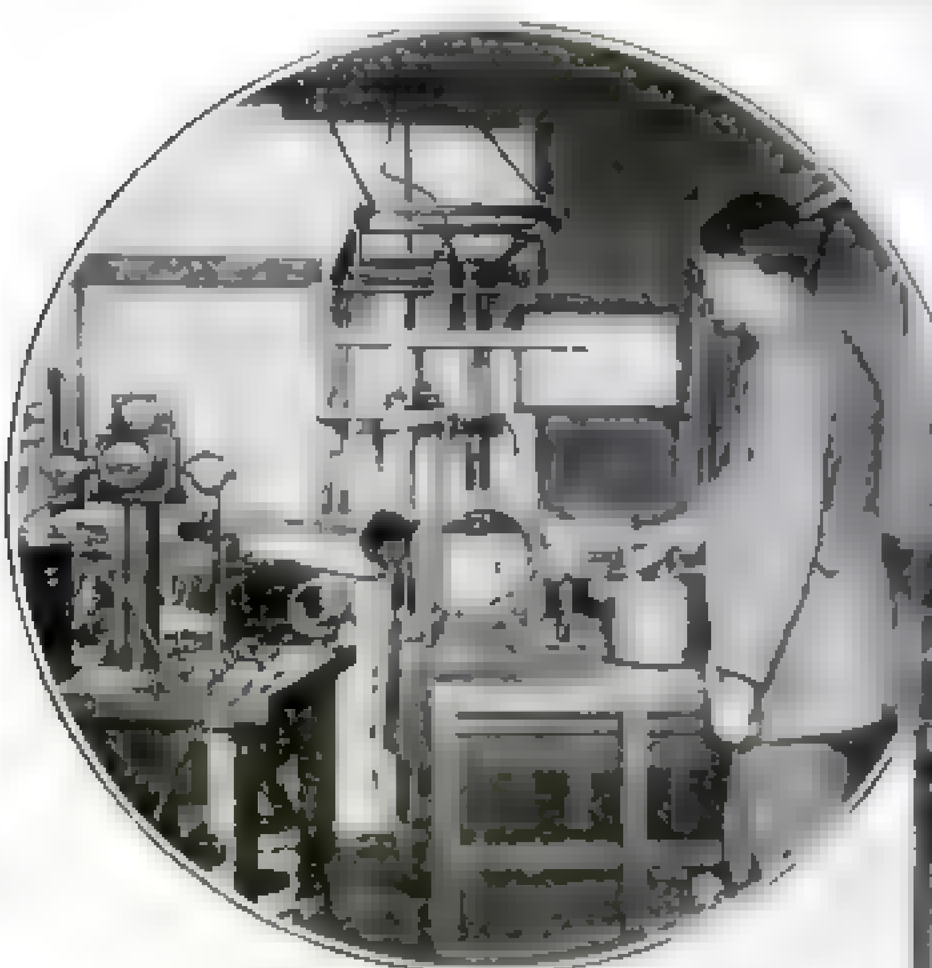
Socket Has One Screw

In this new type of socket adapter to the UX type of base, a single screw is used in place of [illegible] of socket base. As shown in the [illegible] the single screw is put through a hole in the center of the base. Four small wings set in the base are forced out [illegible] the socket base when the screw is tightened down and keep the socket from turning loose

Superpower Tubes Water-Cooled

A big problem in superpower [illegible] the [illegible] at WJZ, Bound Brook, N. J., [illegible] power [illegible] of the giant vacuum tubes. If [illegible] system failed, the tubes would be destroyed by the [illegible] heat. By using [illegible] the water in the pipes [illegible] carry off [illegible]





Better Radio Insulation Sought

The only way to determine whether an insulating material really stops the flow of [illegible] current and prevents [illegible] of power is to make elaborate tests. Such tests are being made by the United States Bureau of Standards under the direction of M. S. Strock, seen in the picture above. Glass and rubber, the most commonly used insulators, for instance, are both made in a great number of grades and no two are [illegible] the same insulating value for use with the high frequencies used in radio transmission and reception. The apparatus here shown at work

Uses Fourteen Tubes

Every now and then some radio fan [illegible] himself [illegible] be the last word in [illegible] with tremendous volume. Henry P. Hayes of Boston, working [illegible] produced [illegible] shown above and at the left. [illegible] are used [illegible] the [illegible] power tube [illegible] volume. [illegible] are used. Of course [illegible] condensers and [illegible] as well as [illegible]. The cost of [illegible] was about $[illegible]50

New Tubes Reduce Distortion

Fine Quality and Volume Follow Use of Power Tubes That Can Be Fitted to Any Kind of Radio Receiver

By Alexander Senauke, M.E., E.E.

HAVE you noticed how your loudspeaker begins to rattle on the high notes and otherwise distorts the music or speech when you try to get the broadcasting really loud? The chances are, you blamed the loudspeaker. Most people do, and yet at least ninety percent of the trouble is not in the loudspeaker at all, for most of the loudspeakers made today are capable of producing plenty of volume without serious distortion.

The trouble is in your set, and the seat of the trouble is generally in just one place—the last tube of the audio amplifier end of the receiver. The minute you try to get any great volume out of it, the last tube overloads and fails to send on to the loudspeaker the powerful impulses fed into it by the other tubes in the set.

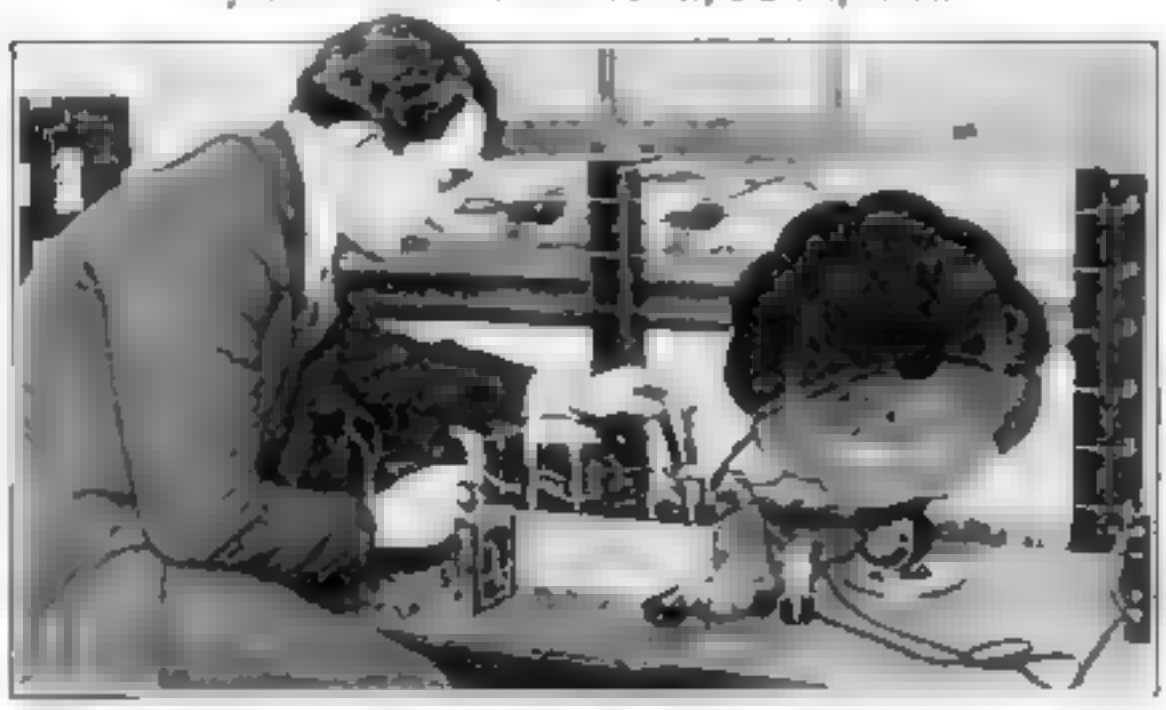
This state of affairs has been studied by radio engineers for some time and various remedies have been proposed. One consisted of putting two tubes in parallel in place of the single tube used in the last stage. This arrangement allows greater volume without distortion, but to get best results from it, it is necessary to have tubes that are pretty well matched; and there are other disadvantages.

The problem of large volume without distortion has finally been solved, however, by the development of several types of tubes especially built for the purpose. The illustration at the bottom of the page shows three styles of these new tubes. The tube in the center, known as the UX-120, or CX-220, works wonders in the way of increased volume, with fine quality, in any set using three-volt dry cell type tubes. The other two tubes are the UX-112, or CX-212, and the MU-6. They are both for use in storage battery operated sets.

What you will want to know is whether these tubes can be used in your set, and what changes will be necessary in order to make them work properly.

You can use one of the new power tubes in any type of commercial or home-built radio receiver.

The best results are obtained with all of the new power tubes if a higher than normal B battery voltage is used, and one of the changes you will have to make will be to arrange your wiring so that this extra voltage is not applied to the other tubes.



Testing the New Power Tubes with Various Transformers

Although our tests at the Popular Science Institute of Standards have shown some difference in the relative efficiency of the new power tubes when they are used with different audio transformers, a marked improvement was noted in every case

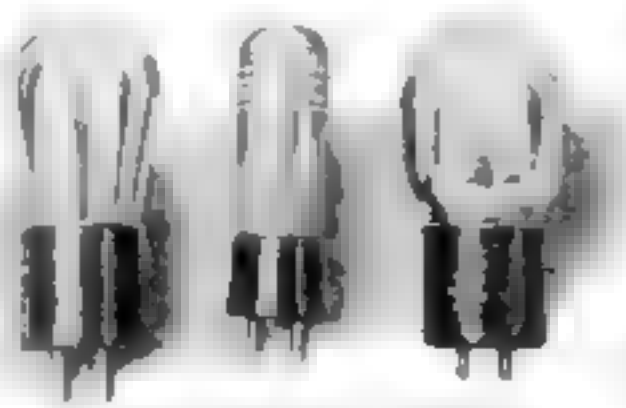
There are so many different types of radio sets that the simplest way to discuss the changes you will have to make will be to explain the method of checking up the wiring in such a way that it will apply to any set so that you can go over the wiring in your own set and note how these changes apply.

All the new power type tubes have been designed for use in just one particular socket in your radio set—that which gives the final stage of audio amplification. Your first problem is to determine which socket in your set is the last. The way to do this is to trace back from the binding-posts or the jack to which you connect the loudspeaker. You will find that one of these binding-posts or one lug of the jack is connected directly to the terminal marked "P" on one of the sockets. This is the socket where the power tube must be used. The other binding-post or lug is always connected to the plus B amplifier binding-post either directly or by way of other wires.

Cut this wire out of the circuit between the loudspeaker binding-post and the wires to which it is soldered or joined and connect the loudspeaker binding-post or jack lug to a new binding-post that you must fit into your set. Assuming that you are now using a ninety-volt B battery, add another forty-five-volt block with the minus end connected to the plus end of your ninety-volt battery and connect the plus end of the new block to the binding-post you have just fitted into your set.

Now look over your power tube socket again and you will find that one of the wires from it goes directly to one terminal of one of the transformers. This is your second stage transformer. Look it over carefully and you will find that another wire from this same transformer goes to the wires that form part of the A battery circuit or, if your set is wired for a C battery, it can be traced to the minus C battery binding-post. Cut it out and make the connection from the transformer to a new binding-post that you will have to fit.

Connect the minus end of a nine-volt C battery to this post if you use the storage battery type of power tube or to the minus end of a small sized 22½-volt B battery if you use the UX-120 tube in a dry cell operated set. The plus end of the battery in either case should be connected to the regular plus C binding-post.



Some of the New Power Tubes

One of them can be used in your present set and your reception will be greatly improved in quality and volume. If you do not want to change your wiring according to the instructions in this article your dealer can supply you with an adapter that will provide for the necessary changes in wiring

THE next step is to put the power tube in the socket and turn on your set in the regular way. If you find that one of the rheostats gets so hot that it will burn your fingers, replace it with another rheostat of the same type but of lower resistance. In most cases this will not be necessary.

There is no power tube made for use in sets that operate with 11/2-volt batteries, but if you have a set of this type it is possible to purchase an adapter that will permit the use of the UX-120 tube which operates at three volts. The adapter is fitted with the necessary extra wires so that you readily can make all of the additional connections for the extra A battery, B battery and C battery voltage needed in this arrangement.

As soon as you tune in a station after the power tube has been fitted, you will notice an increase in the volume together with a marked improvement in the quality of reproduction.

Helps for Radio Beginners

How to Connect Your Antenna

Other Useful Hints to Improve Your Set

THE BEST possible outdoor antenna would be a wire about 100 feet long running from the antenna binding-post straight up in the air. Such an antenna is, of course, impossible for the average radio fan. But keep this idea in mind in putting up your antenna. In other words, have the free end of the antenna as high as possible and as far from steel buildings as possible.

Ground wire should be connected as shown in this drawing

Local conditions affect reception, and it is a good idea to try another arrangement if the first antenna does not bring in stations as it should. Don't condemn an antenna on a one or two evenings' trial. Test it for at least two weeks in order to judge its value under changing conditions of the weather.

It makes no difference whether the antenna and lead-in wire are one continuous piece, so long as all connections are really soldered and not merely stuck together.

Battery terminals should be kept free of corrosion from acid leaks or fumes

YOU cannot obtain good and clear reception with any receiver that requires a ground connection unless that connection is as short as circumstances will permit. To make a really good ground connection, run a wire from the binding-post marked "Gnd" to the nearest cold water pipe and then be sure the wire makes a good, tight contact with the actual metal of the pipe.

To be sure of a good connection, sandpaper or file the surface of the pipe until the bright metal of the pipe shows clearly. Then apply the ground clamp or wind the bare, scraped end of the wire tightly around the pipe for fifteen or twenty turns and twist the ends of the wire together.

A SCREWDRIVER should have a blade that fits the slot in the screw. If it does not, the screwdriver will slip and either disfigure the screw head or scratch the radio panel. The sides of the screwdriver blade should be nearly parallel. If rounded off, the screwdriver should be ground back into shape.

Takes Grit Out of Condenser

Dust between the plates of condenser may be quickly removed with an ordinary pipe cleaner

THE BEGINNER should not hurry in connecting the batteries in his desire to get the receiver into operation. The haste results in poor connections and noisy reception. Satisfactory results depend on a steady, uninterrupted flow of current from the A battery through the tubes, and a smooth flow is impossible with imperfect battery connections.

Connections to A batteries must be watched carefully for corrosion on the terminals. Make your connections clean and tight in the first place and then take them off and clean them every few months.

IF YOUR head or ears ache after listening with headphones for an hour or so, the trouble is in the fit of the phones. Bend the head band so the ear pieces press gently against your ears and the weight of the headset is spread over a considerable portion of your skull and you will feel no further discomfort.

YOU WILL be surprised at the different effects obtainable simply by moving the loudspeaker about from place to place in the same room. Often a harsh loudspeaker will be improved if it is moved to a different corner of the room. Fine tone results are often obtained by moving it into an adjoining room separated by a portiere.

THE instructions for a vacuum tube receiver usually read, "Turn on the tubes by means of rheostat which is connected to knob N and proceed with the listening," but the beginner does not know how much to turn the rheostat. If the vacuum tubes are the dry cell type operating at slightly less than 1½ volts, turn on the tubes in a dark room and look down into the tubes while adjusting the rheostat. When you notice the first red glow in the center of the tube proceed to turn in a station. With the three-volt dry cell or the storage battery types the filament should glow a full yellow.

Rounded end on a screwdriver spoils screw head and scratches panels

Many types of storage battery vacuum tubes are so heavily coated on the inside with a silver-like deposit that it is hard to judge the brightness, but by testing first in a dark room you will be able to see the filament glowing faintly through thin spots in the coating. The new tubes, dry cell or storage types, should be operated at a dull red. Always operate your tubes turned down as far as possible, for maximum life.

Headache is avoided by fitting the ear phone headpiece snugly across skull

A RADIO RECEIVER requires little attention. However, some dust works its way inside the cabinet, settles on the instruments, and, collecting between the condenser plates, may slightly affect the dial adjustment. Cheesecloth will remove all it sees except that between the condenser plates, which can be cleaned out with an ordinary pipe cleaner.

The A B C's of Radio

NO ONE can tell how far you can receive with any number of tubes until an actual test is made.

1. *Investigate the sets used by your neighbors.*
2. *Ask your radio dealer what set he recommends.*
3. *Reception of distant stations is rarely the same two nights in succession, so it is of no importance unless that station can be brought in almost every night during favorable winter weather.*
4. *For loudspeaker reception from stations outside of your city your set must have at least two stages of audio amplification, and three tubes.*
5. *To be sure of distance and quality, buy a set approved by the Popular Science Institute of Standards.*

Latest Aids for the Autoist

A Real Bed for a Ford Coupe

(Right) More comfortable and roomier than a standard Pullman bed is this novel built-in bed for a Ford coupe. It is designed to put an end to worries about [illegible] sleeping, cumbersome equipment and the fear of rain and wind storms. When open it extends the full length of the car. It is attached at the top to the roof and at the bottom to the rear of the chassis. When closed, it folds in a roll behind the seat and does not interfere with luggage

A Safe Seat for Baby

To hold small children safely in an automobile this metal chair has been developed. It replaces the seat and is held firmly in position by the cushion, on which the child sits. A cloth from on the device is wrapped about the child and is fastened to the frame, thus giving the driver free hands. The chair frame may be bent to fit any car

Brake Stops Creeping

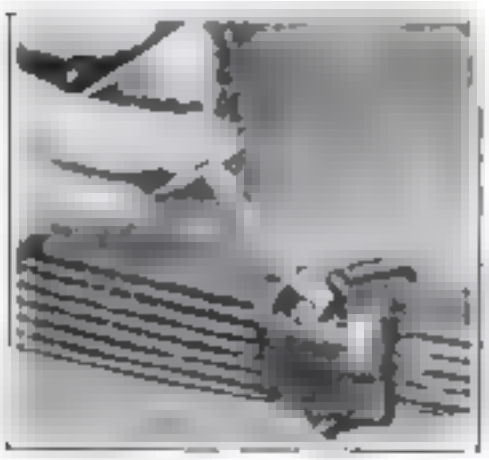
A new safety brake for Fords, shown at the left, that can be installed in five minutes, applies the foot brake when the lever is pulled. It is highly efficient for parking and for holding the car on a hill the maker says and keeps the car from creeping while being cranked. Its use does not change operation of the levers, it is said

Tire Spreader Makes Tube Changing Easy

With a new type of tire spreader, shown above, it is possible to change tubes and examine the inside of the shoe without getting all dirty. Two of these spreaders are generally used together. They are easily handled, as can be seen here in the picture

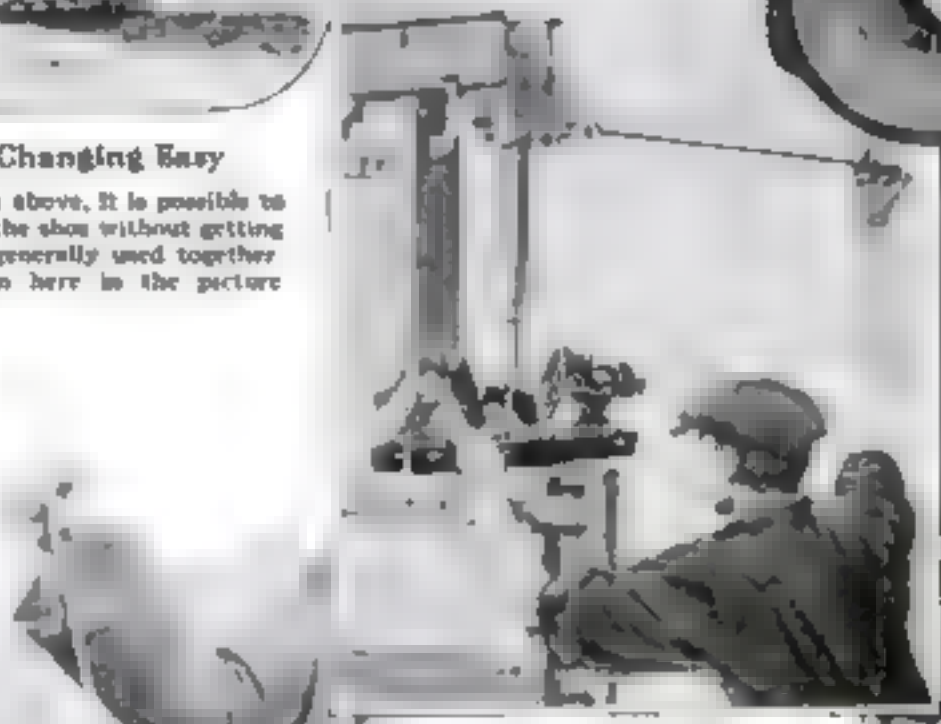
A Keyless Dial Lock

An automobile lock that is said to be absolutely thief proof is in the form of three dials above capable of over 13,800 different combinations. It has no keys, springs, or turn bars to lose or get out of order



Cup Wick Oils Springs

To keep the leaves of the springs properly oiled, there is a cup-like attachment, seen above, filled from the top. It contains a felt pad which acts like a wick in feeding oil to the leaves



Press Trues Up Parts

The heavy steel attachment, above, for garage presses, is said to straighten flat auto parts such as connecting rods, and round pieces like crank shafts, ram shafts, or axles, as well as other accessories

Starter Retards Sparks

To stop the jamming or breaking of the Ford starting system by back-firing due to forgetting to retard the spark when starting, a new safety starter, worked by a special lever, which automatically retards the spark, has been recently invented. The new invention is shown at right

A Crankcase Oil Gage

The oil gage shown at the right is useful in measuring the quantity of oil in a Ford crankcase. The petcock on the case is removed and the gage inserted. A scale registers the quantity

Gus Tells How to Adjust a Carburetor and Shows

How to Cure Starting Trouble

By MARTIN BUNN

Gus put the car on high and walked around to the rear. Seizing the tire with a quick heave he pulled it toward him, and after several attempts the motor broke into a fitful coughing, then ran steadily

"THESE FISH will have to taste extra good to make up for my getting up so darn early," growled Gus Wilson sleepily as he and his partner crawled into Gus's car.

"Humph!" exclaimed Joe. "You weren't so grouchy the day I went rabbit hunting with you! If you would learn how to handle a fly rod maybe you'd be as keen on fishing as you are on hunting."

The two owners of the Model Garage had set out before dawn to get in a few hours fishing, and thanks to Joe's skill, they had a string of speckled beauties.

Gus's sour answer to Joe's sarcastic remark was to kick the self-starter button and try his best to make good time over the bumpy wagon trail that led to the mountain stream.

As they were about to turn into the state highway, Gus slammed on the brakes. Stalled squarely across the trail was a mud-covered, battered touring car. Nobody was in sight, but when Gus honked the horn a tall, lean individual crawled out from under the car.

"Howdy, stranger," he saluted cheerfully. "Reckon I'm blocking the road a bit. Jest a second while I push it out of the way."

He stepped around to the back of the car, and resting one enormous, grease-smeared hand on the back panel, proceeded to lean his weight against it. It started to move at once.

"What's the trouble?" Gus inquired, for a stalled automobile was as much of a challenge to the veteran auto mechanic as a red flag is to a bull.

"Blamed if I know," replied the lanky individual. "If it was a horse, now, I could tell you, but these gasoline animals are a plum mystery to me. Leastways that goes for why it stopped—here's why I can't get it started again," he concluded dejectedly as he held up the crank handle. He had broken it off short.

"Let's have a look at it," said Gus. He climbed out of his car and proceeded systematically to eliminate one possible trouble after another. In a few minutes he gave a grunt of satisfaction.

"Here's part of your trouble," he stated. "This foot gasoline saver has come loose and air is leaking into the manifold so fast that it spoils the mixture. Here—give me a wrench and I'll tighten it up for you. When you strike the next town I'd suggest that you throw it away and put a plug in the hole."

The owner grinned sheepishly. "Reckon that's one on me, stranger," he said. "The garage man in the town I just passed sold me that. He claimed that it would make the gasoline last twice as long."

"Applesauce!" snorted Gus. "If all the devices that are guaranteed to double your mileage were put on one car and they did what they were supposed to do, you ought to be able to take gasoline out of the tank after each trip instead of putting it in!"

Gus tackled the carburetor until it flooded and gasoline began to drip from the bowl in order to be sure the supply pipe was not clogged.

"Suffering cats!" he grunted. "That stuff sure smells fierce. Did you get your tank filled where they stung you for the gas saver?"

"Yes," replied the owner. "I bought five gallons there. I got a bargain, too—two cents cheaper than the last."

"Bargain nothing!" said Gus emphatically. "That's the other part of your trouble. The damned stuff is rotten. Joe, draw off some gas from the vacuum tank and we'll get this motor started."

"But how're you going to get it started?" inquired the owner curiously. "The crank is broken."

"Got a jack?" Gus asked. "That's it. Now put it under one of the rear wheels and jack her up. Joe, you get some rocks and block the front wheels to keep it on the jack. Now watch!"

Gus put the car on high and walked around to the rear. Seizing the tire as near the ground as he could with a quick heave he pulled the bottom of the tire toward him. After several attempts the motor broke into a fitful coughing and then ran steadily.

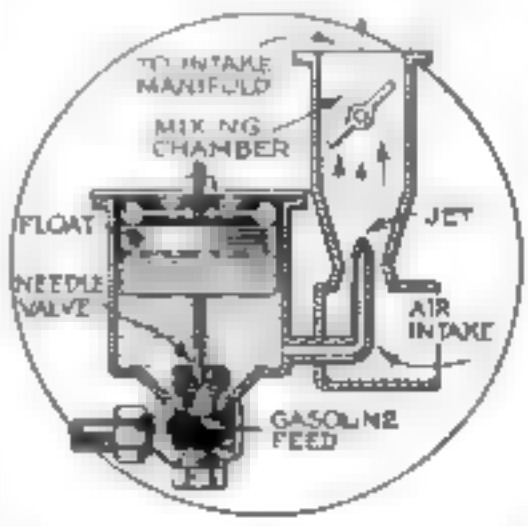
"That's a good stunt to know," he said as he replaced the dirt of his hands. "When the self-starter goes bad and you find the crank has been left at home in the garage, you can get the motor started that way."

"Now let's see what we can do with that carburetor. It sounds like the mixture is too lean, but we can't do anything to fix that until the motor is good and warm. Most people adjust the carburetor before the motor is hot, and that's one of the reasons why they get such poor mileage on gas."

"I'd be darn thankful if you'd show me how to set the carburetor, stranger," said the tall fellow in a hopeful tone of voice.

"All right," said Gus cheerfully. "Come here. Look at this carburetor. See here this is the float chamber. It is just a little tank full of gasoline with a float in it. When the engine uses some of the gasoline the float sinks down with the level of the gasoline and opens a valve that lets in more from the vacuum tank. That makes the float rise and shut off the supply so the level is always the same. That's one thing you must know about the carburetor.

(Continued on page 137)



A carburetor, Gus says, is just a little tank with a float that keeps the gasoline always at the same level, and feeds it mixed with air to the engine much like an atomizer

MEN ARE MAKING

$110 a WEEK TO START!

you can get it!

Floor Experts make *REAL* money,

— and so can you!

Be Your Own Boss in a Trade with No "Dull Seasons" and No "Lay-Offs"!

Send In That COUPON *and we will tell you how to get going*

Floor finishing by the new Electric JOHNSON method is a specialized trade which is NOT crowded. You can start at it without long and costly training. Almost overnight you begin to cash in. And the demand for your work will steadily increase as you create floors of lustrous brilliance. Let the coupon tell you all!

Every worth-while home in town is your sure customer. So is every good store .... every restaurant, hotel, club, hospital, bank, office building. All of them should have their floors polished, their linoleum waxed, REGULARLY. Do such work EXPERTLY—and you collect $15, $20, $25 a day spot cash right along. Others do!

Master It in a Day!

With our skilled instruction, and the Johnson equipment you become a MASTER Floor Polishing Expert at once. It isn't hard work. The Electric Machine does it almost all. You merely wax-film the floor surface and guide the Polisher over it. Instantly there is a burnished, rich gloss, beautifully deep-waxed and long-lasting. You can have all the work you want, day in, day out, the year around. Your pleased customers will recommend you to others.

Billions Dollars of Our Own Money

This year we are spending in nation wide advertising $1,000,000.00 to sell this Electric Floor Waxing ideal to the American people. For forty years we have been the foremost authorities on floor finishing. Now YOU can cash in on this great market.

Homes, Stores, Hotels, Theaters *WANT* This Service NOW!

You don't have to CREATE a demand for Floor Waxing. We have done that and are doing it. EVERY hardwood floor, every yard of linoleum should be waxed. No way compares with this for beauty and permanence. It is YOUR opportunity.

You Won't Have To HUNT Work

People will come to you for this service once they know you are giving it. You will have a prosperous business of your own going almost instantly. From then on all the comforts and many of the luxuries of life will be yours.

JOHNSON'S WAX *Electric floor Polisher*

Simply connect Polisher to any light-socket or electric service outlet. Silently and swiftly the machine does the finest polishing conceivable ten times quicker than by hand. Gets under and around heavy furniture, burnishing every inch of floor.

Clip This Coupon Out and USE It!

This Is No Mere "Correspondence Course" We Offer You!

Our Instruction Service is given absolutely FREE. You invest less than $50 for complete mechanical equipment Waxing Mop—a supply of JOHNSON'S LIQUID WAX and the completely equipped Electric Floor Polisher ready to use. You need nothing more to launch a paying business for yourself.

Send In That Coupon NOW!

At least find out about this wonderful chance to get into business paying around $110 a week from the start. Send in the coupon and get all the actual facts.

S. C. JOHNSON & SON, Racine, Wisconsin
(CANADIAN FACTORY, BRANTFORD)

S. C. JOHNSON & SON P. S. 4, RACINE, WIS.
"The Floor Finishing Authorities"

Please tell me how I can realize $110.00 a week giving expert Johnson Electric Floor Waxing Service.

Name____

Address ____

City ____ State____

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Useful Ideas *for* Motorists

How to Measure Brake Band Linings, and Other Helps

WHEN an automobile stops on the road for lack of gas, the motor does not go dead until every last bit of gas has been drawn out of the vacuum tank as well as the carburetor and the main supply tank. After you have walked a mile or two for a fresh supply, you may find that the motor mysteriously refuses to start.

The chances are about ten to one that the trouble is in the lack of gasoline in the vacuum tank. Of course if you keep your foot on the self-starter button long enough and if you keep the throttle tight shut, the vacuum in the manifold created by the cranking of the motor will eventually refill the vacuum tank. But that procedure is rather hard on the battery.

A much simpler method is shown in Fig. 1. All you need do is loosen the pipe that runs from the vacuum tank to the intake manifold and suck air through it just as you would draw lemonade through a straw, until the vacuum tank fills up. You will not get any gasoline in your mouth.

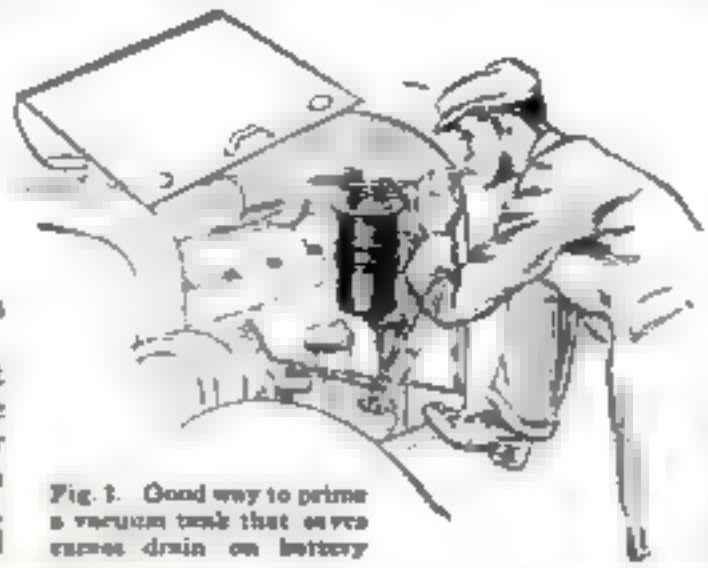


Fig. 1. Good way to prime a vacuum tank that saves current drain on battery

IT IS unfortunately true that there is no standard height for the auto bumper. In fact the height above the ground varies so widely in different types and makes of cars that it is possible, when two bumper-equipped cars run into each other for one bumper to be so far above the other one that they slide right by each other and the cushioning spring action is lost. By bolting old spring leaves to your bumper in a vertical position as shown in Fig. 2, you can make sure that your bumper will engage squarely with any other bumper. In case of accident, the combined spring action of the two bumpers may save serious damage.

Fig. 2. With the use of a couple of leaves from old springs, single bar bumpers will not go under or over the bumper of another car in rear of an automobile crash

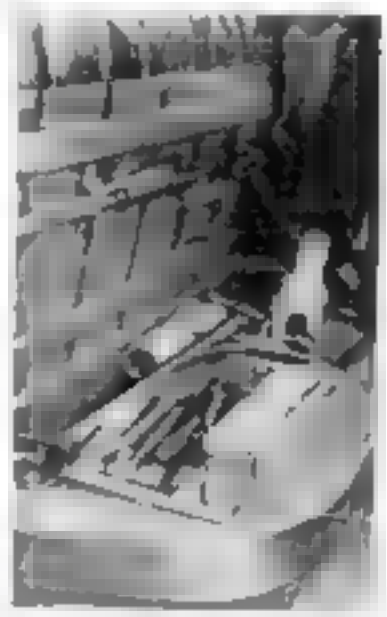


Fig. 3. The old complaint of never being able to find anything in the front seat box is ended by dividing it into handy compartments of various sizes for all necessary tools and equipment

IT MAY be a bit quicker to throw your tools into the compartment under the seat in a haphazard way when you finish a bit of work on the car, but you will find that it saves time in the long run to make compartments as in Fig. 3, for the various spare parts and tools. Then you can find them when you need them the next time, and they will be kept from being damaged in bumping over rough roads. Some of the most used tools can be held by sheet-metal clips to the under cover of the seat compartment.

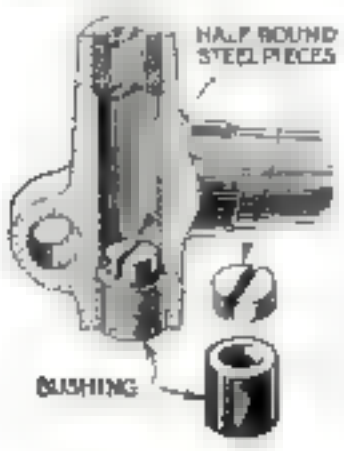


Fig. 6. To take out spindle bushings, a soft steel disk cut in the shape of a half moon has been devised

Fig. 4. By a simple arrangement a trouble light can be attached to front or rear of your car

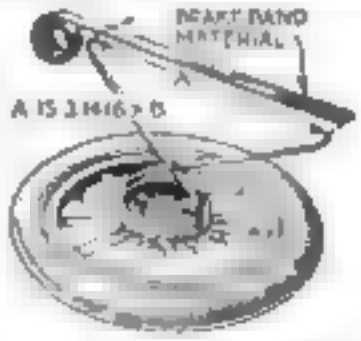


Fig. 5. A handy caliper for measuring a brake band lining saves material, time and patience

IT IS possible, of course, to fit your trouble light with a cord long enough so that the light can be used at any point around the car, but such a long cord gets tangled up easily. You can have a shorter cord and still use the light wherever you need it if you will fit a connecting plug to one of the wires and a battery clip to the other, (Fig. 4.) Then when you need the light at the back of the car for instance, you can take out the tail-light plug, push it into the socket at the end of the wire, and snap the clip on the framework at any convenient point where it will make contact with the bare metal.

This method works with almost all cars, as most cars today are using the single-wire system. If you happen to have a car with the double-wire system, connect the trouble light wires to the two contacts. No battery clip will be needed in this case.

Ten Dollars for an Idea!

GEORGE E. LUERS, of Washington, D.C., wins the $10 prize this month for his method of measuring brake band lining, shown in Fig. 5.

Each month POPULAR SCIENCE MONTHLY awards $10 in addition to regular space rates for the best idea for motorists. Other published contributions will be paid for at usual rates.

BRAKE band lining is expensive material, and the motorist tries to figure his requirements as closely as possible so as to avoid both the cost of buying too much and the loss which follows the cutting of a piece that is too short. It is easy to build yourself a double ended caliper as shown in Fig. 5, that will tell you just the right length of brake lining needed to fit any particular size of brake band. The distance from hinge pin to the short end should be just seven inches if the long end measures twenty-two inches from the hinge pin. This caliper gives a length between the long ends that will equal the circumference of a circle if the short end is set to the diameter of the circle as shown in Fig. 5.

YOU can remove auto spindle body bushings in handy fashion by the use of a steel disk sawed off the end of a steel bar of the right diameter and split crosswise. The halves are dropped through the upper bushing and moved into position as shown in Fig. 6, with the end of a piece of wire. They form a cover for the hole, and the bushing can be driven out with any steel rod that will fit through the hole in the upper bushing.

IT IS certainly worth-while to carry spare bulbs for headlights, sidelights and tail-light on your car. No one can predict just when they will be needed. A simple holder for bulbs, made of wire, is shown in Fig. 7, bent into loops the right size and then screwed into the door frame.

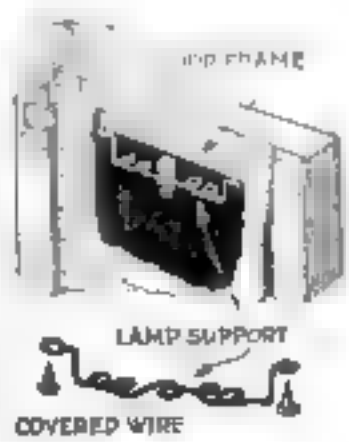


Fig. 7. An easily accessible holder, made of wire protects bulbs and can be fitted in door pocket

Making it easy to do good sawing

YOU make good sawing easy for yourself —or hard—when you buy your saw. For with a saw that chatters, hacks, or binds, easy sawing is impossible.

Smooth, fast, true cutting—this is the beginning of good finished work, the secret of easy sawing.

That is the kind of sawing the Disston Saw has been doing for over eighty years. Henry Disston, training his own workmen, developing his own steel, first made it possible.

Eighty-five years of making saws that cut! Saws that cut faster, because no blade can take and hold an edge like Disston Steel. Saws that cut more easily, for Disston taper in the blade, and the fitting of the handle, give perfect natural balance. Saws that cut straight and true, because they are smithed and filed by Disston master-craftsmen . . .

To saw easily, to saw well, look for the saw that *cuts*. Your own dealer has it—the Disston Saw.

HENRY DISSTON & SONS, INC.
Philadelphia, U. S. A.

Ask Disston

Tell us what work you are doing in wood, metal, stone, ivory rubber leather, cloth, fibre or other materials. We will tell you how to saw it better and easier. Disston issues many free books to aid saw users.

DISSTON

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

"Your radio is always top notch. What do you do to keep it so full of pep?"

KEEPING your "B" batteries full of pep, without frequent renewals, is simply a matter of using the right size Eveready's for your particular set with a "C" battery*.

The rule which determines the right size "B" batteries to use is so simple no one can make a mistake, and once learned it definitely settles the question of "B" battery service and economy

On 1 to 3 tubes — Use Eveready No. 772
On 4 or more tubes — Use the Heavy Duty "B" Batteries, either No. 770, or the even longer-lived Eveready Layerbilt No. 486.
On all but single tube sets — Use a "C" battery.

When following these rules, No. 772, on 1 to 3 tube sets, will last for a year or more, and Heavy Duties on sets of 4 or more tubes, for 8 months or longer.

These life figures are based on the established fact that the average year-round use of a set is 2 hours a day.

A pair of Eveready No. 772's for a 5-tube set instead of 2 Eveready No. 770's or 2 Eveready Layerbilts No. 486—looks at first glance like an economy because of lower first cost. But in a few months the 772's will be exhausted and have to be replaced. After the same length of time the Eveready No. 770's or the Eveready Layerbilts No. 486 will still be good for many more months of service.

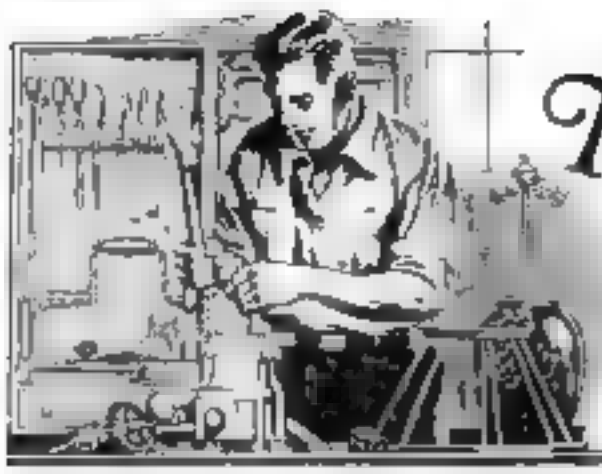
We have prepared for your individual use a new booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you upon request. This booklet also tells about the proper battery equipment for use with the new power tubes.

*Note: In addition to the increased life which an Eveready "C" Battery gives to your "B" batteries, it will add a quality of reception unobtainable without it.

Manufactured and guaranteed by
NATIONAL CARBON CO., Inc.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

Tuesday night means Eveready Hour 9 P. M. Eastern Standard Time, through the following stations:

WEAF—New York
WJAR—Providence
WEEI—Boston
WTAG—Worcester
WFI—Philadelphia
WGR—Buffalo
WCAE—Pittsburgh
WSAI—Cincinnati
WTAM—Cleveland
WWJ—Detroit
WGN—Chicago
WOC—Davenport
WCCO { Minneapolis / St. Paul
KSD—St. Louis
Pacific Coast Eveready Program,
KGO—San Francisco, 8 to 9 P. M.



The Home Workshop

Arthur Wakeling, *Editor*

What My Home Workshop Has Done for Me

By CHELSEA FRASER
Instructor of Industrial Arts
Grand Rapids Public Schools

"IT WON'T take long to tell *that!*" was my first flying thought when the editor asked me to prepare an article for his readers under the above title. But the more I gave it thought, the more the subject grew; and when I actually sat down to jot off a tentative little list of kind acts done me by my humble home workshop, the tabulation expanded and expanded until I was absolutely amazed. In fact, I straightway saw that I should have to begin culling right away; that never in the world could I squeeze into my allotted space all of the services lavished upon me by my dumb benefactors, the home tools.

As I look back now to the time when I was five or six years old, a "reg'lar little kid among other reg'lar little kids," I recall most vividly that my first mechanical thirst was awakened by a bright new jack-knife my father, a carpenter, was using in shaping me out a miniature sailboat. I thought that knife, with its shining, razor-like blades, was about the finest thing in all the universe, and I had not the slightest doubt that in my own hands it would perform whittling stunts fully equal to his.

I tried to persuade him to let me use it, but he only laughed me off and said, "Wait till you're older, laddie; you'd only get a bad cut now." But I watched my chance and sneaked the knife out in the woodshed one day. A few minutes later my mother was kissing away my tears and wrapping a bandage around my left forefinger. Forthwith I began to gain proper respect for edged tools.

ABOUT a year later, I traded a cherished rubber ball to a schoolmate for a rusty old Barlow knife with one blade. To my delight, my father not only let me keep this, but also repointed it for me, sharpened it and polished it up.

The next day I lost it—of course. The boy who had traded it to me found it. He admired its reconditioned aspect so much that he refused to return it to me when I saw him with it, and a fight ensued. I had always been afraid of this fellow, who was larger, but the thought of regaining my knife spurred me on. When the dust cleared away, I had my knife once more. Two days later, while walking on my hands in a vacant lot, I lost it again, this time for good.

My next jack-knife, the prized of the years, was one I earned by picking cherries for a neighbor. I had that quite a while—almost two weeks—before I lost it.

Altogether, I guess a half-dozen different jack-knives were called mine for brief periods during the next two or three years, and in-between I was a most inveterate borrower of Mother's paring-knife, and sometimes of her butcher-knife. Her patience with me was wonderful.

Mr. Fraser Making a Phonograph Horn

Although he has written fifteen books and is known the country over to woodworkers in the furniture trade through his contributions to the technical press, Mr. Fraser takes the greatest pride in his chosen work in the Grand Rapids public schools, which he describes picturesquely as "teaching boys to make shavings"

Father's tolerance was not quite so marked. Because I nicked one of his choice gouges one day in trying to pry out a tenpenny nail, he ordered me to keep away from all of his tools. This was a hard blow for me, as I had just become the captain of a troop of "soldiers" and had taken upon myself the task of providing each private with a full-sized wooden Springfield musket with a tin bayonet. I was in a real predicament.

But I managed to wangle out by collecting from the aforesaid privates enough rusty old tools to worry through, with my contract, although I had to compromise and allow each tool owner to share in the glory of firearm production. The work was done in our basement, in an unoccupied corner that my father and I might call my workshop, and the bench was nothing more elaborate than a stout packing-box.

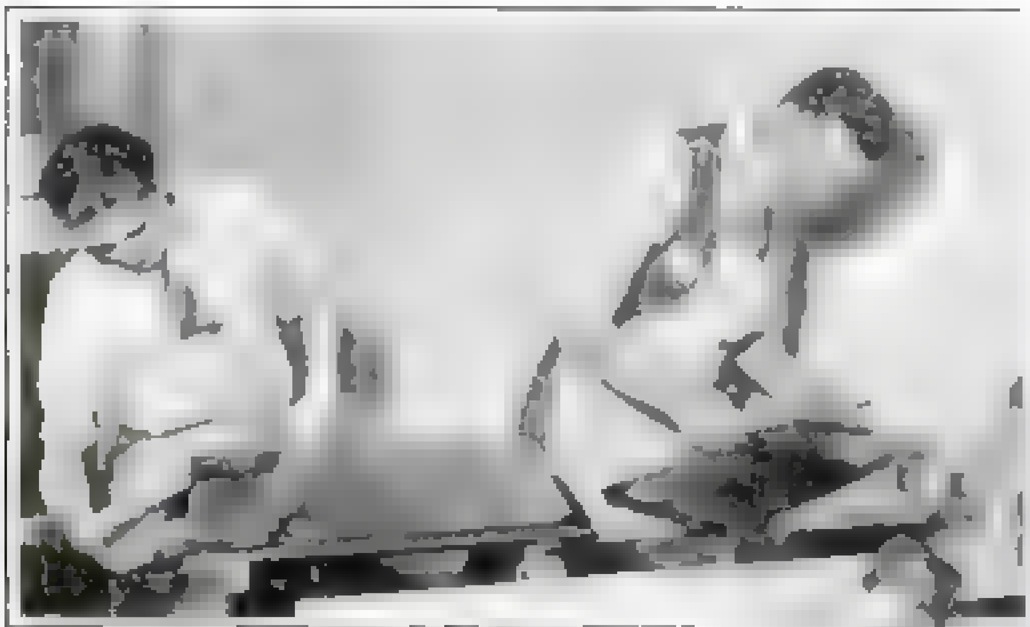
Since we could not all work on the "bench" at one time, the idlers turned inspectors and critics, until their jibes and sarcasms irritated the workmen into throwing down their tools with an exasperated "Do it yourself then, Smarty!"—whereupon offices alternated once more.

THAT was the beginning of my first home workshop—a packing-box and a few rusty tools brought in by my boy friends. The box remained, but, when my companions left, the tools went with them. Then the barrenness of my humble little "shop" goaded my ten-year-old soul to desperation. I would have some tools of my very own—yes-siree! Nor would they be rusty, worn-out tools, either, but bright, shining, sharp ones, just like Dad's! I would get busy, earn some money after school, and buy a tool at a time, until I had an outfit equal to the finest!

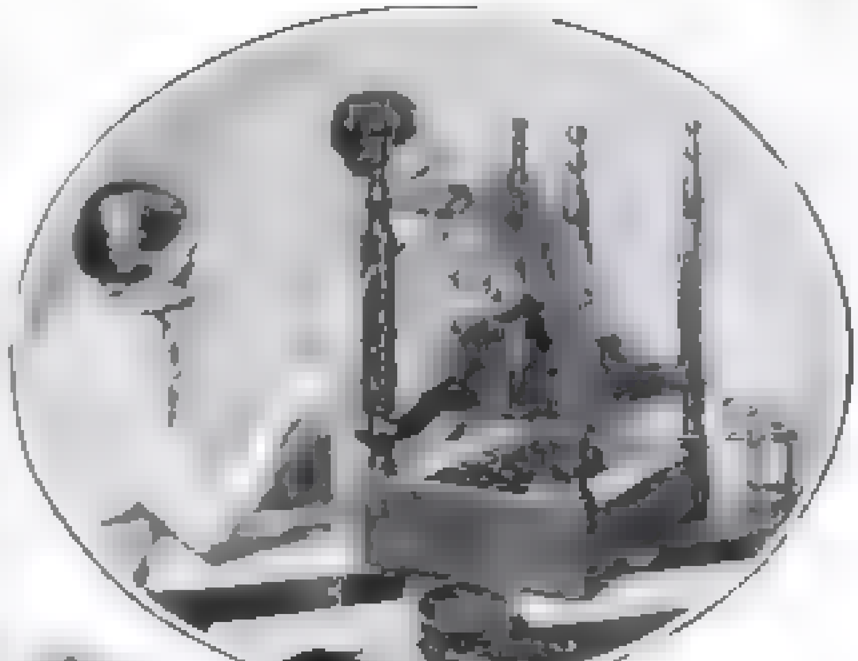
And I carried out that resolve to the letter. A tool at a time! That was my youthful watchword for years. I ran errands, sold old rubbers and iron and rags; carried newspapers. I attended my self on candy and worked my way into the few shows that I attended. As fast as I could save enough pennies, nickels, and dimes to buy the next important tool on my list, my father would accompany me to the store and help me select it. His judgment on good steel was ample safeguard for my investment.

Because I bought these tools myself with my hard-earned money, because I anticipated the purchase of each many weeks before it would come into my possession, my gathering assemblage was very dear to me. I took the greatest care not to nick them, and (*Continued on page 94*)

Secrets of Successful Varnishing



Varnishers follow a certain methodical order in their work and hold their brushes as shown above



Mr. Waring demonstrates above how to hold a brush in order to work from the center of a leg toward the edges. Then [illegible] long off strokes with [illegible] of burnt [illegible]. At left, smoothing [illegible] with [illegible] paper and rubbing [illegible]

How to refinish your old furniture like an expert—The trick of rubbing with pumice

By Ralph G. Waring
[illegible]
Automobile Finishes

WHILE the 12:30 whistle was still blowing, Dan came bustling into the laboratory, full of smiles as a morning in June.

"Do we start the finishing work today, Mr. Waring?"

"We certainly will, Dan," I assured him. "Our first operation will be to apply a thin coat of shellac over the re-sanded stain coat. A solution made from one part of stock orange shellac from the can and three parts of denatured alcohol is about right. Apply it with this two-inch *fitch* flowing brush—just enough to cover.

"Do not expect any shine or gloss when this coat dries. The drying should take only about two hours in this warm room.

"When you get through fold some 0-0 double-surfaced garnet paper into eighth sheets and split each piece in half edgewise, starting from a crumpled corner. This makes the paper thin and flexible so as to cut fast and clean. Then, when you come in at lunchtime tomorrow, sand the shellac coat until glass-smooth and dust off for filling."

THE surfacing of certain types of sandpaper on both sides with abrasive material is, of course, only for convenience, so that splitting one sheet gives two sheets for use. The more usual form of sandpaper to which the home mechanic is accustomed can be split just as easily and the heavy backing paper thrown away.

Sometimes it is not easy to obtain from local dealers a grade of sandpaper finer than 2-0 or 3-0. These grades will serve fairly well if used with great care, especially if the sheets have been worn beforehand to some extent in the sanding of clean woodwork. The finer grades often can be obtained, even in five and ten cent stores, by purchasing small pads of sandpaper put up not for wood-finishing but for cleaning kitchenware.

When the sanding had been done, we prepared a so-called "natural" silex wood filler by thinning the paste with two parts gasoline and one part turpentine until it was the thickness of heavy cream. In order to match our mahogany, we added burnt umber, Vandyke brown, and a little rose lake. These were "ground in oil" colors. They can be obtained in small tins, or, if small work is being done, in the form of tube paints or artist's oil colors. Dry colors also will serve, and ten cents' worth of each will keep the home worker supplied for a long time.

The filler is applied roughly but thoroughly with an old brush and allowed to stand until the turpentine shine is gone. Then it is "padded in" with a piece of burlap until the pores of the wood are leveled off and full.

"Finish with a piece of old cotton cloth and be sure that no traces of free filler are left to harden," I told Dan. "Sharpen a soft pine stick to a pencil point on one end and a chisel edge on the other and use it as a picking stick to clean out all edges and corners. Then set aside the work to harden from twenty-four to forty-eight hours."

When the filler had hardened, the surface was gone over lightly but carefully with split 0-0 paper to clean up any cloudy parts. It was dusted thoroughly and then a coat of one part of shellac to two parts of alcohol was applied.

IN OUR case, the shellac was tinted with alcohol soluble Bismarck brown and alcohol soluble nigrosine, to a rich red brown. This is the best practice, but the tinting can be omitted by the amateur finisher for the sake of simplification. Just a tiny bit of each color was added, a mere pinch. When dry, the work was sanded clean with split paper.

Now we were ready for the varnish work. In this, the control of dust is always the biggest problem. A clean room, clean apron, freedom from drafts, sleeves rolled up out of the way, all go toward a good job. A clean brush and clean work are essential.

I called Dan's attention to a vegetable can, the top of which had been cut off with a circular can-opener and then cut with a chisel so that the brush could be slid through and a nail pushed through a hole in the handle just above the ferrule and through the can cover. The can is kept nearly full (Continued on page 96)

Turned portions of the legs are rubbed with a cloth and the moldings with a rubbing brush

easiest—quickest—surest Way to Fix Punctures

DEALERS Write Now

for attractive window display and tie your store to our big national advertising campaign in magazines like The Saturday Evening Post, Liberty, Popular Science Monthly, Popular Mechanics, Motorists and Farm Papers.

You know what tough luck it is to get stuck on a country road with a puncture, with nothing to fix it but some temporary cold patch material and messy rubber cement. It spoils your whole day's fun and makes you wish you were home.

But there's a quick, easy way out of all this trouble, as millions of motorists have found. They always carry one of the handy little Shaler Vulcanizers in their cars for emergency use on the road. Last year they fixed fifty million punctures with this inexpensive little vulcanizing outfit.

Why not get a Shaler and carry it in your car too. Then when the emergency comes all you need do is to clamp a Shaler Patch-&-Heat Unit over the puncture; light the prepared solid fuel it contains; give it a few minutes to cool—and you have a *heat-vulcanized* permanent repair that lasts.

The complete outfit includes the vulcanizer and 12 Patch-&-Heat Units. You can get it at any auto supply store for only $1.50. Slightly higher in Canada and far West.

C. A. Shaler Company, Waupun, Wis., U. S. A.

How to Utilize Your Cellar

Fitting Up a Home Workshop in the Basement—An Easy Way to Obtain Extra Light—Methods of Making a Damp-Proof Billiard or Play Room

By William Draper Brinckloe

Member of the American Institute of Architects and the American Society of Agricultural Engineers

WHERE should I put my workshop? That was something of a question! There was an old shed that might answer during the summertime, but it would be bitterly cold in winter. And winter is just the season when one has leisure for shopwork; cars and golf clubs no longer lure one outdoors, then!

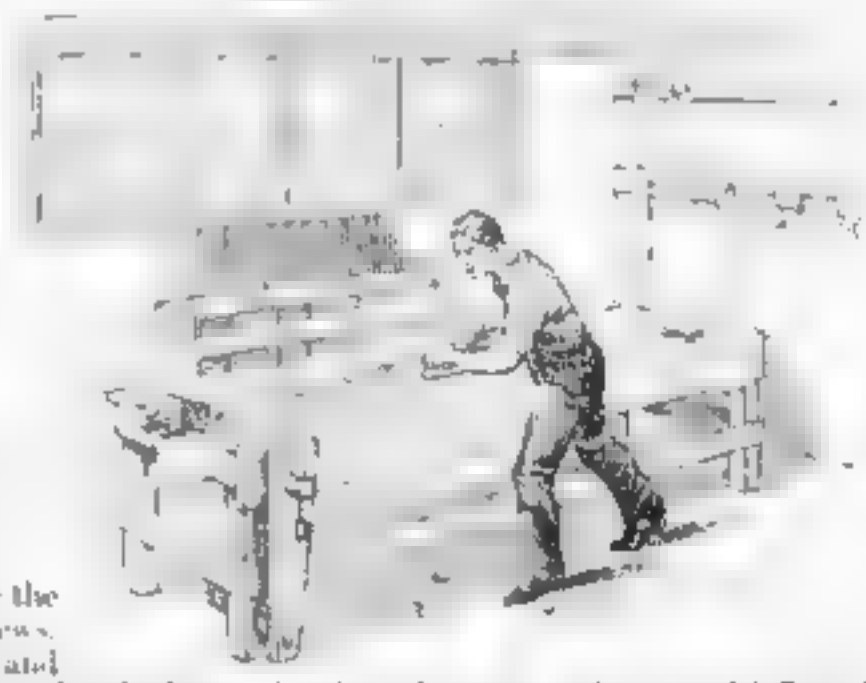
So I turned to my cellar—warm, dry, but a bit dark. The place where I wanted to put my workbench had just one small window. Of course, there were electric lights, but it seemed absurd to waste current in daytime. Moreover, artificial lights, unless very carefully placed, are apt to throw shadows in just the wrong places on your work.

From the cellar wall at the top, I cut out a section large enough to allow four 4-light cellar sash to be fitted, as you see in both of the accompanying illustrations. The ground had to be dug away a bit to clear the bottoms of these windows, but that was easy to do.

Between the sash, I set short pieces of 2 by 4 in. studs to support the sill of the house. These formed the window-frames. The sash were hinged at the top, to swing up against the ceiling. Copper insect-screen cloth was tacked over the openings, outside.

The sketch shows my workbench. This required four rough boards 10 in. wide and 8 ft. long for the top and apron, four pieces of 4 by 4 in. lumber each 3 ft. long, for the legs, three 6-in. boards 7 ft. 6 in. long for braces, and four 6-in. boards 2 ft. 6 in. long for cross-pieces.

It might be well, if you make a bench like this, to lay cross-boards on the lower braces of the bench to form a shelf for paint cans, lumber, and such things.



Mr. Brinckloe, who is a noted architect and, as a writer on small house planning, has given assistance to many thousands of home builders throughout the country, built a workshop in Edgemar, his home at Easton, Md., with four windows above the bench, as are shown at the right

These cross boards should be 2 ft. 6 in. long; they can be made of old boxes and scrap lumber.

The pigeon-holes above the bench hold tools, nails, screws, paintbrushes, hardware, and the thousand and one odds and ends that look so useless, but turn out to be just the thing for some tinkering job! I used ordinary wooden grocery boxes with shelves fitted across the middle.

A row of hooks on the wall or ceiling for handsaws and large tools completed my cellar shop, and wonderfully convenient that shop is, I find!

But maybe you have your shop in the garage or the attic. Very well, you won't want another shop, but you may wish a billiard room or den.

The lower illustration shows a cellar billiard room that I designed for one of my clients. The wall was damp, so we waterproofed it thoroughly, plastered it with cement, and then built a new brick wall inside it, to keep the water pressure from pushing off the plastering.

Ordinary red bricks were used, laid with ends out, they did not break joints, but gave the effect of a red-tiled wall. The pattern was made with cream white bricks; it represented two very convent-realized skeletons playing a game of pool.

The floor was covered with red magnesite flooring—waterproof and dustless.

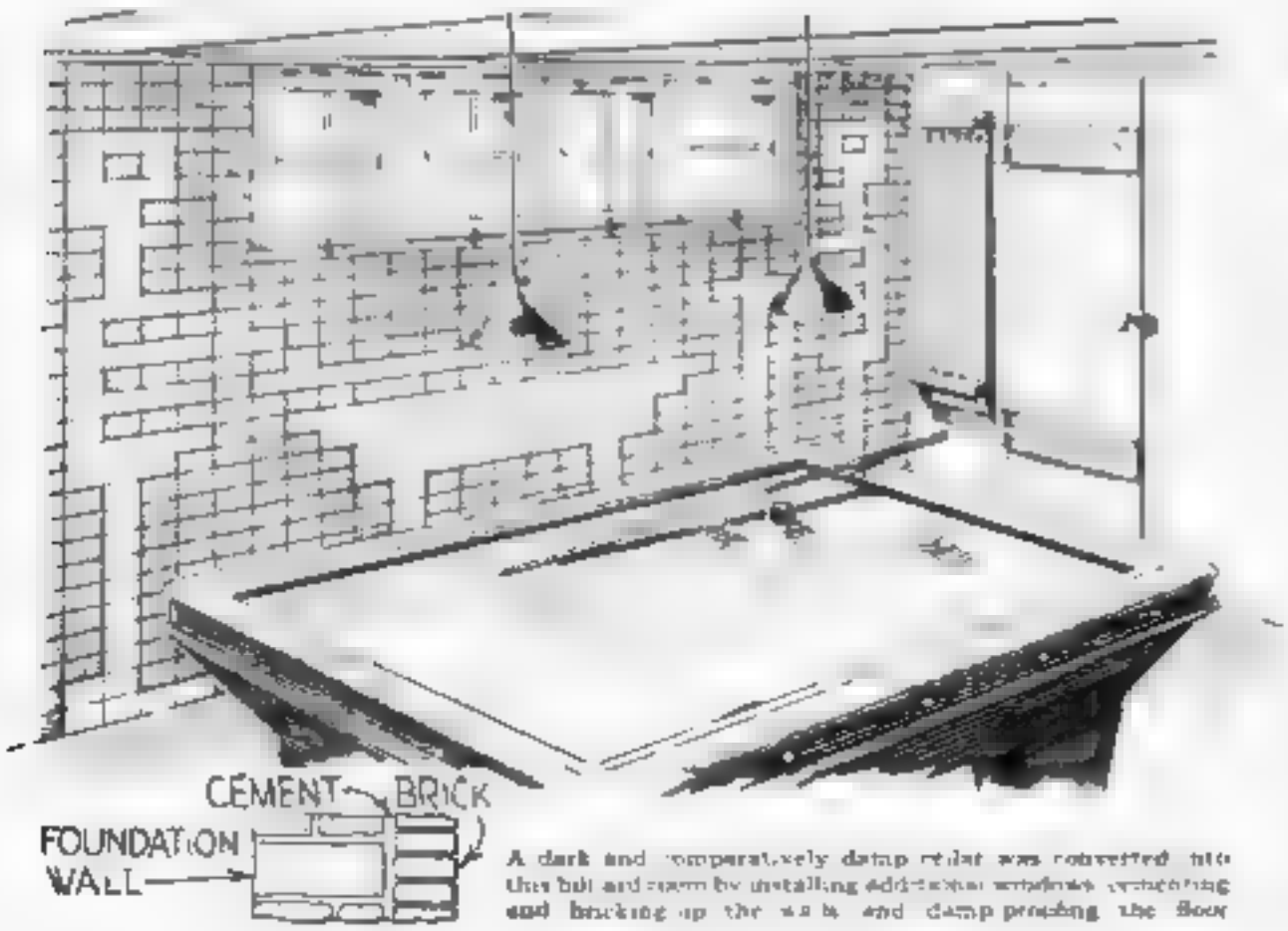
ONE of my friends has fitted up a part of his cellar as a playroom for his children. Of course he had to make it absolutely dry, or their health would have suffered, but that was not a difficult to do. The walls and floor were finished as I have just described for the billiard room, except that a layer of concrete was used, instead of the bricks. Incidentally, the Portland Cement Association, 111 West Washington street, Chicago, issues a valuable bulletin on waterproofing old cellars.

Then the walls were painted and stenciled in bright colors with special concrete paints. Some old bureaus, which always may be obtained at little cost from second-hand furniture dealers, if the attic storeroom does not yield one or two of them, were fixed up as toy lockers.

Turn to page 78 for the continuation of the Home Workshop Department.

We Will Pay for Other Good Cellar Ideas

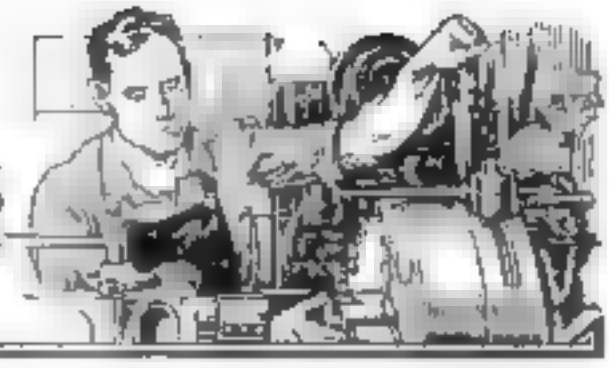
MEASURED in dollars and cents, the cellar space in the average small house costs a great deal. Too often, however, it is of little real value except as a place for the heating plant, coal bin, and, sometimes, laundry tubs. If you have worked out good ways to use your own cellar or have any ideas on the subject, describe them to the Editor. If your letter promises to be helpful to other readers, it will be paid for at regular rates and printed.



A dark and comparatively damp cellar was converted into this bil iard room by installing additional windows, whitening and bracing up the walls and damp proofing the floor

Better Shop Methods

How Expert Mechanics Save Time and Labor



Speeds, Feeds—and Your Job

By Albert A. Dowd, *Consulting Engineer*

"SAY, Tom," said young Harvey Smith to the gang boss on the screw job, "what's this stuff about fifty feet a minute cutting speed I hear these efficiency engineers talking about? One of them told me yesterday to increase the speed on the big turret lathe to twenty-four revolutions per minute on that cast-iron ring job—and I was only running about thirty-five feet a minute and I ought to have at least fifty feet. The machine was running at seventeen revolutions, and he increased it to twenty-four. Where did he get that dope? I don't understand it."

"Well, Harvey," replied Tom, "I haven't got it very clear myself, but it's something like this: Those engineers have it all worked out scientifically, and they figure that different metals like cast-iron, steel, and brass should be cut at different surface speeds to get the best results. You and I know that we cut brass faster than cast-iron, and, of course, we run a small piece much faster than a large one; but I don't just know how they figure what it ought to be before trying it out. These new-fangled schemes don't always work out in practice the way they do on paper."

"No, I know they don't," said Harvey, "but there must be some good reason in what they do, because the other day on that bronze job we couldn't get the facing tools to stand up over a couple of hours, until we slowed down the speed as the efficiency man said. How did he know that was the reason? All the other tools kept sharp all right except the one on the large diameter. He said I could not expect a carbon tool to stand up on bronze at one hundred and twenty feet without a lubricant."

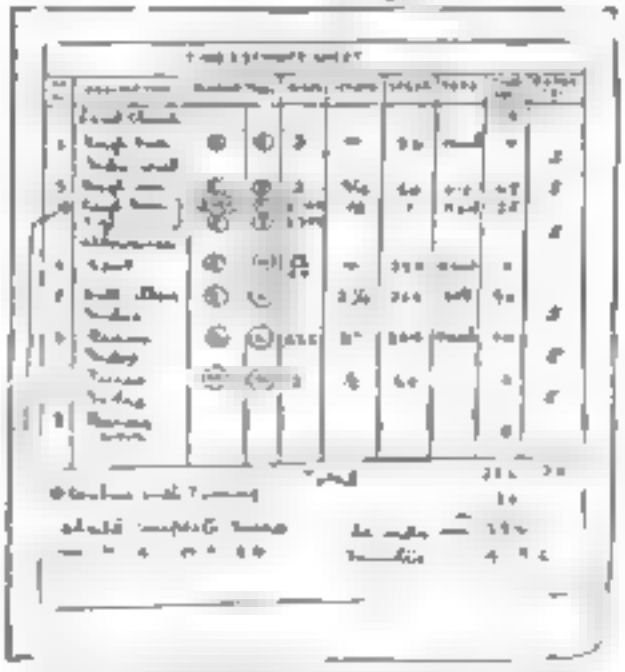


Fig. 1. Harvey was able to speed up his lathe work after he understood this time estimate

"Yes," replied the gang boss, "that's a fact, but just the same you ought to have known enough to slow it down yourself when you found the tool wouldn't stand up."

"But, Tom," countered Harvey, "you set the speed yourself—and anyhow it looked all right. I thought the metal was probably pretty hard, just the same, I'd like to get some dope from those fellows. Do you think they'd tell me how to work it out if I ask them?"

"Sure," said Tom. "I'll ask Mr. Grimes to come over and talk with you." With that he walked away.

Now, Harvey Smith was just an average young mechanic, hard-working and painstaking. He had plenty of ambition and a desire to get somewhere. So, when Mr. Grimes came around the same afternoon, he said:

"Mr. Grimes, I want to know how you figure out how fast a piece of work should run, and I wish you would tell me what this 'feet per minute' means. I can't get it through my head!"

"I'm glad you are interested, Harvey," responded Mr. Grimes pleasantly. "I'll show you with pleasure and it's as simple as A B C." He pulled out a pad and a pencil and drew a quick sketch as reproduced in Fig. 2.

"Here's a piece of work four inches in diameter at A and here's your cutting tool (B). The work is turning in the direction of the arrow. If you imagine the work to revolve once, (Continued on page 10)

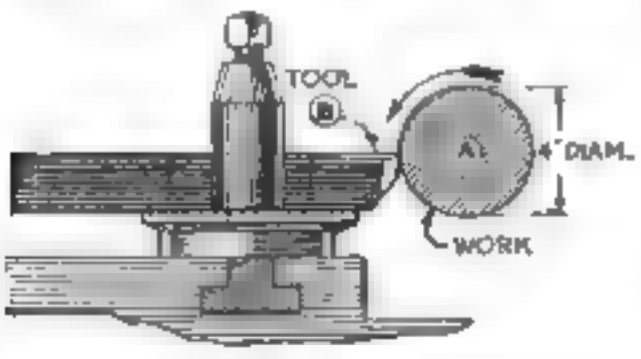


Fig. 2. The diameter and the number of revolutions are needed to figure the cutting speed

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, which you will find on pages 105 to 113.

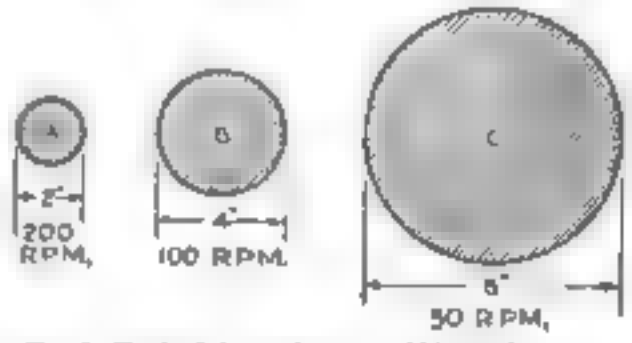


Fig. 3. Each of these pieces would have the same surface or cutting speed of 104.8 ft. a minute

An Expert Simplifies Baffling Shop Problems for the Machinist

WHETHER you work in a small or a large shop, you can turn to profitable use many so-called "high-production" or "efficiency" methods.

The trouble is that the mechanics and engineers who have made possible the amazing feats of modern manufacture, as in the production of automobiles, talk in technical and mathematical terms. Their language generally is not understood very well by the mechanic at the machine. Yet there is nothing mysterious or obscure about better shop methods; the best and easiest way almost always is the simplest.

The Editor therefore, is glad indeed to have enlisted the co-operation of Mr. Dowd, one of the outstanding authorities on machine shop efficiency, in writing a series of articles to tell the individual mechanic how to utilize and profit by the latest and most approved methods of the production engineer. The second article will appear in an early issue.

The Home Workshop

Houses the Birds Really Like

By F. E. Tuttson and A. G. Brown, *Scout Institute, Menomonie, Wis.*

Fig. 1. The wooden bottoms rest on cleats and may be removed very easily for cleaning

Fig. 2 (above). Wren, bluebird and woodpecker houses of standardized design built according to the specifications below

Fig. 3 (at left). Substantial wall bracket to support a wren house

DO YOU know the secret of building a birdhouse that really will be lived in by some other bird than the ever present and always disreputable English sparrow? It is to make the house exactly the right size to suit the species of bird you wish to attract.

You can accomplish that easily by using the standardized design shown in the accompanying illustrations in conjunction with the table of sizes at the bottom of this page.

Birds are among our best friends. They consume seeds of obnoxious weeds and plants and, according to the biological survey of the United States Department of Agriculture, they are nature's most important agency for keeping down insect pests. The protection of the birds, therefore, is of vital interest to everyone.

Nest boxes should be put up wherever practicable and shrubbery planted to replace the wild growth in which the birds once built their nests. It has been proven that birds return in greater numbers each year to localities supplied with proper nesting facilities.

A one-room, box-like birdhouse of simple design (Fig. 2) is recommended. If desired, a covering of bark or slabs of wood may be added to improve the appearance.

It is essential that you have a definite bird in mind before you start to build a house, as birds have strong likes and dislikes. Study the

(Continued on page 94)

The Proportions to Use When Building Birdhouses

Species	Floor of cavity	Depth of cavity	Entrance above floor	Diameter of entrance	Height above ground
Bluebirds	5 by 5 in.	8 in.	6 in.	1½ in.	5 to 10 ft.
[illegible]	6 " 6 "	8 "	[illegible]	[illegible]	6 " 15 "
[illegible]	4 " 4 "	6 or 10 "	6 or 8 in.	1½ in.	6 " 15 "
[illegible]	4 " 4 "	8 " 10 "	6 " 8 "	1½ "	6 " 15 "
[illegible]	4 " 4 "	8 " 10 "	6 " 8 "	1¼ "	12 " 20 "
House wren	4 " 4 "	6 " 8 "	1 to 6	½ "	6 " 10 "
Bewick's wren	4 " 4 "	6 " 8 "	1 " 6 "	1 "	6 " 10 "
[illegible] wren	4 " 4 "	6 " 8 "	1 " 6 "	1½ "	6 " 10 "
Violet-green swallow	5 " 5	6 "	1 " 5 "	1½ "	10 " 15 "
Tree swallow	5 " 5	6	1 " 5 "	1½ "	10 " 15 "
Barn swallow	6 " 6	8	*	*	8 " 12 "
Purple martin	6 " 6	6 "	1 in.	2½ in.	15 " 20 "
Song sparrow	6 " 6 "	6 "	**	**	1 " 3 "
[illegible] grosbeak	6 " 6	6 "	4 in.	2 in.	8 " 12 "
Starling	6 " 6 "	16 or 18 "	14 or 16 "	2 "	10 " 25 "
Phoebe	6 " 6 "	6 "	*	*	8 " 12 "
Crested flycatcher	6 " 6 "	8 or 10 "	6 or 8 in.	2 in.	8 " 30 "
Flicker	7 " 7 "	16 " 18 "	14 to 18 "	2½ "	6 " 30 "
Golden-fronted woodpecker	6 " 6 "	12 " 15 "	9 " 12 "	2 "	12 " 30 "
Red-headed woodpecker	6 " 6 "	12 " 15 "	9 " 12 "	2 "	12 " 30 "
Downy woodpecker	4 " 4 "	8 " 10 "	6 " 8 "	1¼ "	6 " 30 "
Hairy woodpecker	6 " 6 "	12 " 15 "	9 " 12 "	1½ "	12 " 30 "
Screech owl	8 " 8 "	12 " 15 "	9 " 12 "	3 "	10 " 30 "
Saw-whet owl	6 " 6 "	10 " 12 "	8 " 10 "	2½ "	12 " 20 "
Barn owl	10 " 16 "	15 " 18 "	4 "	6 "	12 " 18 "
Sparrow-hawk	8 " 8 "	12 " 15 "	9 " 12 "	3 "	10 " 30 "
Wood-duck	10 " 18 "	10 " 15 "	3 "	6 "	4 " 20 "

*One or more sides open. **All sides open.

Are You Really Well Informed?

Test Yourself with this Famous Questionnaire!

EVERYBODY is talking about the famous "Popular Science Questionnaire." In the panel is the list of questions of which the Questionnaire is composed. How many of them can you answer?

These questions were prepared, after a great deal of thought, by a group of eminent scientists. Their test has become famous throughout the country as the "Popular Science Questionnaire."

Like an Old-fashioned Examination

May we ask you to make this test carefully, reading the questions slowly and giving thought to each one? When you cannot answer one satisfactorily to yourself, put a zero (0) beside it.

On the other hand, give yourself credit of four (4) for each satisfactory answer. Then when you are through, see how near you have come to making a mark of 100.

This is like an old-fashioned examination, but you will find it fascinating. The questions all have to do with the wonders of the world we live in. All can be given quick and straightforward answers by any person of education.

All of the questions in the famous "Popular Science Questionnaire" and many hundreds of others, have now been answered, for the first time, in one book—THE POCKET GUIDE TO SCIENCE.

All that you probably ever will want to know about science is told in this one 284-page book that will fit in your pocket or grace a library table. Curiosity-satisfying facts about the world we live in are made instantly available to you in simple question-and-answer form in THE POCKET GUIDE TO SCIENCE.

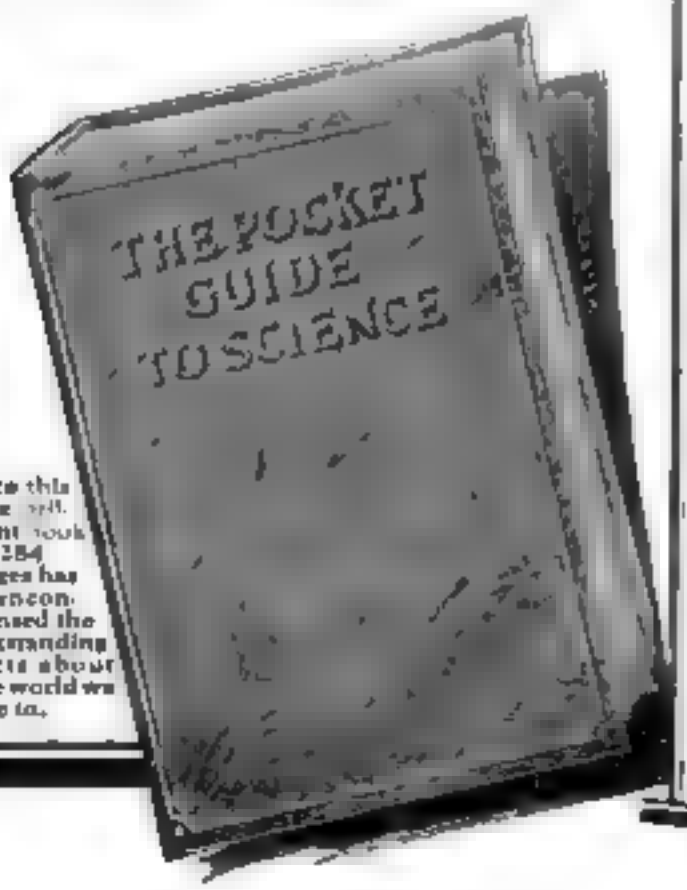
You are assured of the accuracy of the answers in THE POCKET GUIDE TO SCIENCE because it has been edited by Dr. E. E. Free, who has remarkable genius for condensing the known facts about scientific questions into easily remembered paragraphs.

The POPULAR SCIENCE QUESTIONNAIRE

Test Yourself Now

1. Why does radium continue to give out heat for thousands of years?
2. Are the stars solid like the earth?
3. How was the earth formed?
4. Why is glass transparent?
5. How do we know that the earth is slowly shrinking?
6. What is an electric current?
7. How was petroleum formed?
8. Do electrons really pass through wire when an electric current is flowing through it?
9. What physical changes in your body are produced by fear?
10. How do muscles exert power?
11. What are X-rays?
12. Can we see atoms with a microscope?
13. Why does heat expand things and cold contract them?
14. Why does the moon appear to change its shape from time to time?
15. What is the brain made of?
16. Why is it possible that the inside of the earth is growing hotter instead of cooler?
17. Why is frost more likely on a clear night than on a cloudy one?
18. Does thought use up the thinker's energy?
19. Which travels faster, electricity or light?
20. What simple test will distinguish wool from cotton?
21. What makes the noise of thunder?
22. Why would men ultimately suffocate if all the green plants were killed?
23. Does the boiling of water remove the impurities in it?
24. How do the living cells of the body get the energy with which to do their work?
25. How is the speed of light measured?

TOTAL PERCENTAGE



Into this one 284-light book of 284 pages has been condensed the outstanding facts about the world we live in.

SPECIAL OFFER

THE POCKET GUIDE TO SCIENCE is not for sale. It is offered to you without one penny extra cost, with a 14 months' subscription to POPULAR SCIENCE MONTHLY.

POPULAR SCIENCE MONTHLY "carries on" from where THE POCKET GUIDE TO SCIENCE leaves off. THE POCKET GUIDE gives you all that the scientists have discovered up to right now—POPULAR SCIENCE MONTHLY will give you all the important, interesting and new discoveries of science for the next 14 months.

It takes over 300 articles and pictures every month to tell the readers of POPULAR SCIENCE MONTHLY all that has happened in the scientific, radio, mechanical and automotive fields.

Your Name in Gold

THE POCKET GUIDE TO SCIENCE is bound in beautiful flexible fabrikoid. We will stamp your name in 22-carat gold on the cover of THE POCKET GUIDE at no extra cost to you if you use the coupon below immediately.

We extend to you the Special Offer of a 14 months' subscription to POPULAR SCIENCE MONTHLY (regular price by the month would be $3.50) with THE POCKET GUIDE TO SCIENCE—all for $2.95, plus the few cents' postage. If you are already a subscriber to POPULAR SCIENCE we will extend your subscription 14 months if you accept this offer.

Send No Money

Send no money, just the coupon. If within 10 days after you receive the book and magazine you decide that you are not satisfied in every particular, you may return them, and your entire payment will be refunded promptly and without question. Could any offer be fairer?

POPULAR SCIENCE MONTHLY P. S. M. 4-26
250 Fourth Avenue, New York

I accept your offer of THE POCKET GUIDE TO SCIENCE and a 14 months' subscription to POPULAR SCIENCE MONTHLY. I will pay the postman $2.95 plus the few cents postage when he delivers the POCKET GUIDE and the first issue of POPULAR SCIENCE MONTHLY. If the book and magazine are not fully satisfactory to me I will return them within 10 days and you are to promptly refund my full payment. Please stamp my name in gold.

Name _____

Address _____

City _____ State _____

In using Coupon please PRINT Your Name.

The Home Workshop

What Makes My Automobile Jump out of *Second Speed?*

By Ray F. Kuns

Principal, Automotive Trades School, Cincinnati, O.

SYMPATHY was what my friend wanted. He had driven around to see me in obvious discouragement about his auto—an excellent one.

"This car is no good!" he exclaimed. "It pops out of gear as fast as I can put it in. It is almost impossible to keep it in second speed. It jumped out of second on the Hill this morning, and I sure had a time getting started again! Then I had to pull all the way up in low for fear that it would come out again."

"How long have you been having this trouble?" I inquired.

"Oh, that started about six months ago," he replied. "At first I didn't think much of it. I never had really serious trouble until lately. I used to hold it in gear on a bad hill, with my hand on the shift lever, or else prop my foot against it, but now nothing seems to keep it in."

This story is a common one, particularly in respect to passenger-cars that are used in localities where there are steep and continuous grades. As a rule, transmission gears for passenger-car service are built to withstand an average amount of heavy low- or second-speed work, but most of them are so powered that it is not usually necessary to use the lower gears except for starting or in braking on a hill. Transmission gears are always large for this service, yet the failure of gears, as evidenced by this so called "popping" or "jumping" out of second, is rather frequent and deserves some consideration of the causes, remedies, and preventives.

If you will refer to the illustration of the four gears in Fig. 1, you will note two good or new gears and two worn ones, which are to be replaced. It is likely that

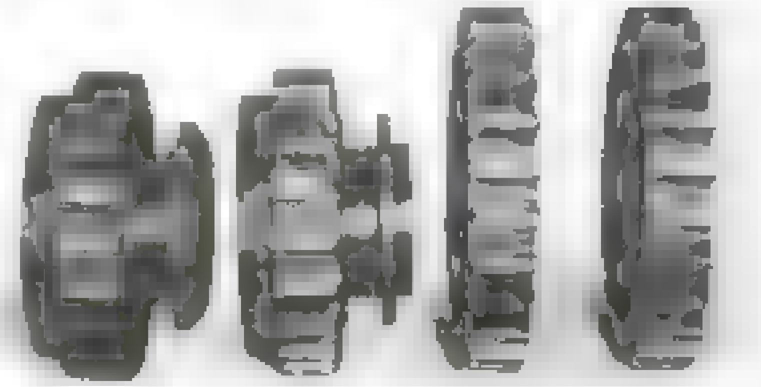


Fig. 1. Compare the worn faces of the two old gears in the center with the new ones outside, which are to replace them

the bad gears (those in the center) had not been meshing fully. This might have been due to a sprung or worn shifting-fork. If the shifting-fork has sprung, it is usually the result of clashing and attempting to force the gears when shifting.

It will be seen that these gears are worn, tapered and the corners well rounded. After pulling on a grade for a little way, these gears would work gradually out of mesh until finally there was so little of them in mesh that they would pop out with a snap.

There is only one remedy for this fault, and that is to replace the worn parts with new ones. This usually means only the second-speed sliding gear and the second-speed jack or countershaft gear.

In some instances, the shifting-fork may be worn and need replacing; in others, the splines on the transmission shaft will be worn so that a gear has no chance to set correctly when under load.

In Fig. 2 is illustrated the gears of a transmission as they appear when in mesh for second speed. It will be noted that they mesh fully. These gears, it might be added, are perfect after ten years of service.

If it should be necessary to replace any gears in a transmission, either because of jumping or because they have been stripped or otherwise damaged, the transmission must first be removed from the car. Next (Continued on page 81)

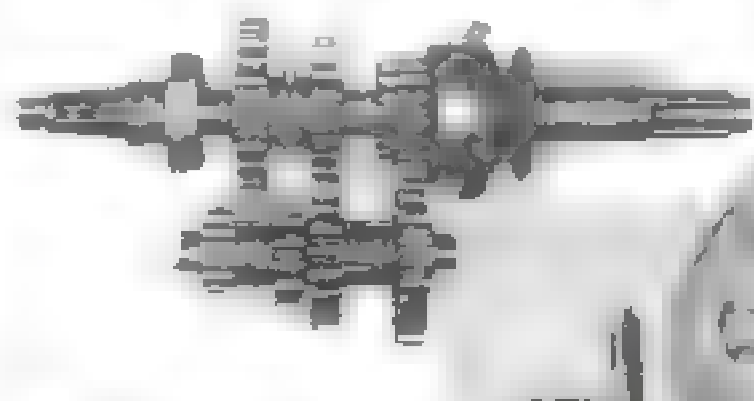


Fig. 2. (Above) This is how the gears of a transmission appear when fully in mesh for second speed. These gears are in perfect condition after ten years' use

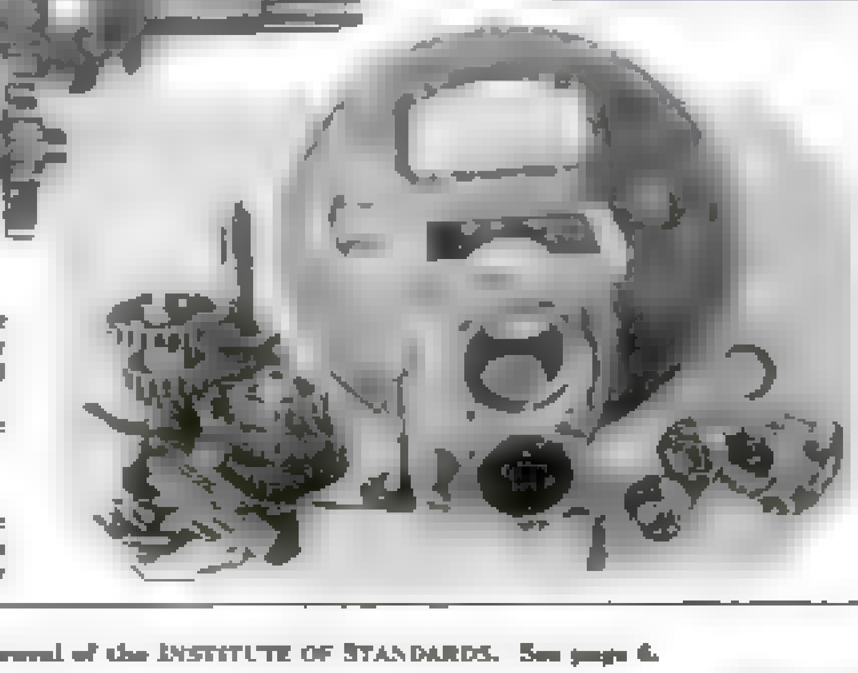


Fig. 3. (At right) To replace worn gears, the transmission must be dismantled completely

The Home Workshop

What Makes My Auto Jump Out of Second Speed?

Continued from page 300

it is dismantled completely as shown in Fig. 3.

The shifting gears, of course, are readily stripped off. There are several methods of securing the fixed gears to the jack or countershaft. The other method is shown in Fig. 4. In this instance, the gears are pressed on to bosses on the shaft and secured by means of the rivets. Remove the rivets, press off the old gears, press on new gears, and insert new rivets.

The countershaft gears shown in Fig. 2 are pressed onto the shaft and held from turning by Woodruff keys. In such a case, press off the old and press on the new. Make certain that the notched edges of the gear teeth are in the correct

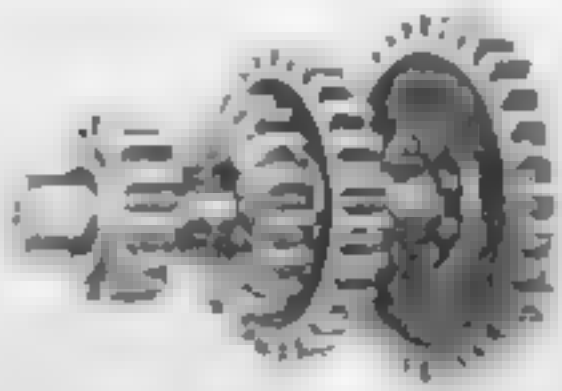


Fig. 4. Fixed gears are fastened in various ways. In this instance they are riveted to a boss

position. If the gear should be reversed, shifting would be difficult if not impossible.

Reasonable care when reassembling is required. See that all parts are in alignment and that the bearings are adjusted properly.

Transmission bearings may be ball or roller although in many instances they are plain bushings. Shims and other devices are used to adjust the end play of the shafts. Make certain that all these adjustments are right and then after the transmission case is over with the shifting forks and cover has been placed, make certain that the adjustment and action is such that gears mesh fully for the width of the teeth.

If the construction does not permit of looking into the case to see the mesh when the gears are shifted, it is well to use red lead or bearing blue. By placing it on the teeth of the sliding gears, get an impression on the gears they mesh with when they are shifted and the transmission shaft is turned over a few times by hand.

If the impressions do not show a full mesh, correct the trouble by adjusting or bending the shifting-yoke as the case may be. In some cases it will be necessary to put in new shifting-forks or yokes. At any rate, full mesh is essential to long gear life.

To avoid a repetition of the trouble, the driver should make certain that the gear shifting operation is so timed that it is without strain on the shifting parts, and that it is completed before a load is allowed to come onto the gears.

How to Make a Common Lapped Dovetail Joint for Furniture

By EMANUEL E. ERICSON, *Noted Manual-Training Authority*

1 In using a dovetail for connecting a rail to a leg in furniture construction, first lay off distance on the rail and square across

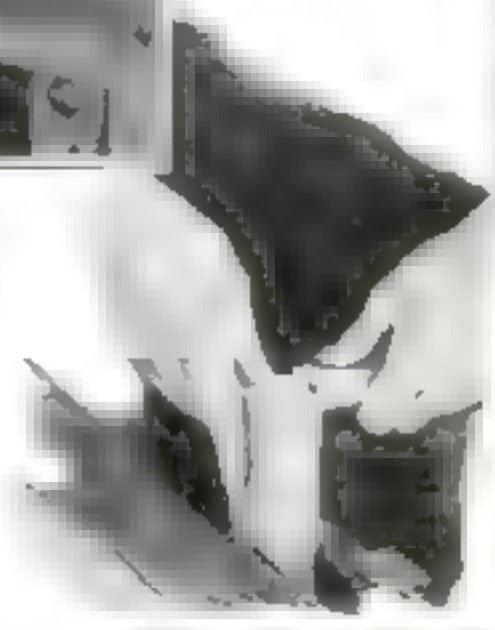
2 Draw 60- or 75-degree lines on both sides with a bevel square, square across, cut wood with fine saw

3 Set rail on leg even with the end, place try-square as shown, remove rail, and draw a short line with knife

4 Lay rail on end of leg and draw around the dovetail with a knife. Mark the remaining lines with gage

5 (At left) Use a fine backsaw or a dovetail or tenon saw to cut into the corners and down to the limits indicated by knife lines

6 Above: Chisel out the mortise, using the widest chisel that will enter without marring the stock. Use a narrower chisel to clean out the corners. Both chisels preferably should have beveled edges to obtain the exactness desirable



7 (At right) The finished joint should fit so that it can be pressed together by hand; it should also be well glued. Much used in furniture construction, it has the advantage that it prevents spreading of connecting parts

The Home Workshop

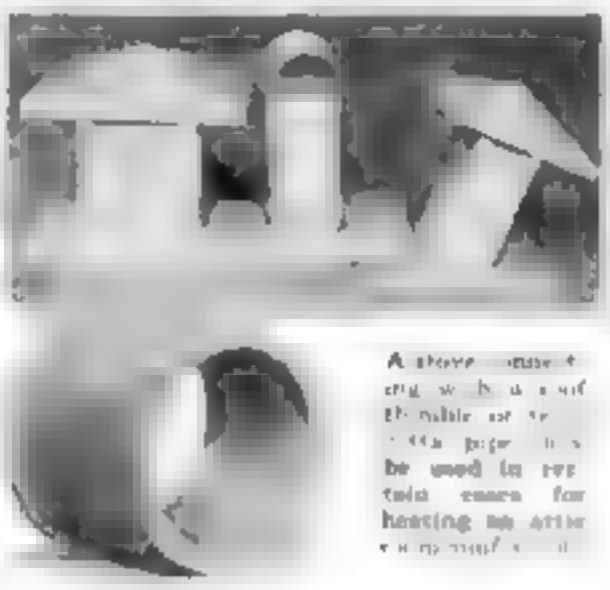
Our New Attic Room Receives All Its Final Touches

By Edwin M. Love

WHETHER the woodwork of a newly finished attic is to be painted or varnished, it should be well sanded and all hammer marks scraped out.

If paint is to be used, my own preference is to prime the wood with paint thinned with boiled linseed oil and then follow with at least two coats of paint as it comes from the can. Never paint over undercoats not thoroughly hardened. Interior paints generally are thinned with turpentine, or turpentine substitute which dries considerably more quickly than oil.

Some woods, such as white pine, exude a sticky honey-colored sap or pitch which is apt to break through and disfigure the finish. This can be removed by



wiping with a cloth moistened in gasoline, kerosene or turpentine; or, if sufficiently hardened, it can be scraped off, drop by drop, with a knife. Inspect all the wood for such "fatness" and treat before painting with a coat of shellac.

If the woodwork is to receive a varnish finish, it may be left its natural color or stained. Apply the stain or dye with a brush or wad of waste, and be ready with a dry rag to wipe off the surplus from the soft spots in the wood which otherwise, with dark stains, might go entirely black.

Although stains appear to dry almost instantly, it is good practice not to apply varnish sooner than 24 hours after staining.

After being stained, open-grained woods, such as chestnut and oak, must be filled either with paste or liquid wood filler, preferably the former. (See Mr. Waring's article on page 72 for the best method of filling wood and applying varnish.)

If fiber wallboard has been used, it should be painted according to the manufacturer's instructions (or refer to my article, "A New Way to Cover Cracked Plaster," on page 81 of the October, 1925, issue).

Plaster or gypsum wallboard may be either papered (continued on page 8)

The Home Workshop

Our New Attic Room

(Continued from page 83)

or painted. Regular plaster should be allowed to stand undecorated for some time before being papered or painted

It is best not to nail down the base shoe until the painting is done. If the floor is to be covered with linoleum, cut the linoleum to fit close to the baseboard and let it lie loosely for two or three weeks or till it has stretched. Then trim where necessary, tack down and apply the base shoe with 1-in. brads, toe-nailed into the baseboard

There are several solutions to the problem of heating an attic room. If the house is piped for gas, a pipe sometimes can be run through a partition by boring through the upper and lower plates. In difficult places a flexible conduit ordinarily may be used in the same way. A steam radiator often may be connected economically with the heating plant if of the steam type. When the house is heated with hot air, the cost of putting in an additional hot-air register and pipe for the new attic room usually is prohibitive.

If a wood or coal heater is installed, a few simple precautions must be taken. The floor, and the wall behind, should be insulated from heat with asbestos pads, and where the pipe passes through the ceiling and roof, either terra cotta or ventilated galvanized iron thimbles are necessary. In many localities these are not permitted because of the fire hazard involved, and it is wise to look up the local building ordinances in regard to this matter

If a brick chimney is suitably located, as often happens, the pipe can be led into it. The home mechanic is warned, however against any "breast" chimneys of brick he might feel capable of building, as nearly all city ordinances require brick chimneys to rise from suitable foundations in the ground. Wall brackets are entirely taboo.

By all odds the simplest pipe outlet, when one must be used, is that rising through the ridge of the roof where the draft is greatest and the amount of water received by the roof in a storm is least.

If the flue must be brought out on the slope of the roof, a cap similar to those in the photograph is necessary. The roofed-over top prevents downward winds from forcing the smoke down the pipe.

This is the last of a series of eight articles on fitting up an attic room. If you are planning to undertake work of this kind, it will pay you to look up the entire series, which began in September, 1925, or obtain back copies by writing to the Circulation Department, POPULAR SCIENCE MONTHLY. For additional information on painting, see page 99.

Window Polishing Brick

A POLISH for cleaning windows and mirrors may be made from 1 part plaster of Paris and 2 parts of 850-mesh silica mixed in water and placed in a greased soap-dish or other mold to harden.

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

THERE are many forms of crack fillers, each for a special purpose

Open joints in floors that are to be painted may be filled with putty. A priming coat of paint should be applied first or the cracks well oiled, so that the putty will stick. Force the putty into the cracks with a knife and remove all surplus from the boards. Then paint as usual.

Cracked plaster walls are best repaired with commercial patching plaster. Plaster of Paris mixed with thin glue size and with a small amount of hydrated lime added, if at hand, may be used. Mix only a small quantity at a time.

If plaster walls are to be painted with oil paints, the cracks may be filled with thick white lead to which either precipitated chalk or plaster of Paris has been added. If the walls have already been painted, the crack filler may be colored until it matches.

Cracks in furniture, toys and other woodwork, if not too extensive, can be filled with commercial plastic wood or

Using a paste of sawdust and thin liquid or carpenter's glue to fill an open joint

with wood sawdust or file dust mixed with thin liquid or carpenter's glue. Mix a few drops of the glue and a little wood dust until a thick paste is formed, and apply with a knife. Let the mixture harden slightly and then rub the wood with fine sandpaper. This covers the crack with very fine dust, which is held by the soft glue and conceals the defect

Nail-holes and cracks in built-in furniture, trim, and standing woodwork can be filled after the first coat of shellac varnish or paint has been applied with a putty made of dry white lead and linseed oil, preferably with a little varnish added. Color to match with dry burnt or raw umber, burnt or raw sienna, yellow ochre, lamp black or similar powders, which can be obtained very cheaply at the paint store.

To fill similar defects in cabinetwork or furniture, use stick shellac, which can be obtained in any well-stocked paint shop in a large variety of colors, or melt one part flake shellac and one part rosin together and add suitable dry colors. This cement is applied with a hot knife or a soldering iron.

® This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Simple Handicraft Modeling

A Fascinating Method of Decorating Picture Mounts, Boxes, Book Ends, and Furniture Novelties

By BERNADETTE MAHONEY, *Art Instructor*, and WILLIAM T. WELD, *Shopwork Instructor, Peoria High School, Peoria, Ill.*

GESSO, a pasty composition that looks and acts more or less like cake-frosting, offers the home worker a really extraordinary medium for decorating craftwork and furniture.

It can be used with equal success for ornamenting new work and for rehabilitating the beauty of articles that have been relegated to the attic. Even cheap commercial candlesticks, lamp stands, boxes, picture frames, book ends, and similar articles purchased in bargain basements can be given, through the medium of gesso, a touch of distinction and beauty that would justify their display in an exclusive art store.

Using gesso for a low relief border around a picture mount

While the use of gesso is an ancient craft—one practiced extensively by artisans for many centuries, particularly in Italy during the Renaissance—it has special merits from the standpoint of the amateur mechanic. It is not only easily handled, but it also serves to cover poor wood, such as the home worker often has to use, and at the same time conceals defects due to imperfect workmanship.

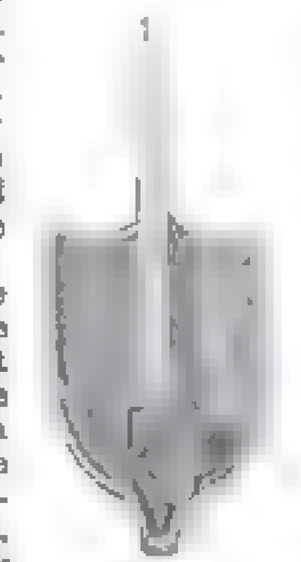
One beauty about gesso is that it can be handled in a multitude of ways. It is not necessary to follow any special set of rules; the tabulation on page 88 is sufficient to indicate the varied possibilities. One specific use of gesso, however, will be described in detail to show the general method of applying it.

The material itself may be purchased or made according to a number of formulas. Two of the best appear on page 88.

Suppose one has cut out an especially attractive cover or a reproduction of a famous painting and wishes to mount it without taking the time to make a frame. Mounts may be purchased already cut in either thin wood or fairly thick cardboard, but they can be made in a moment at home if one has on hand a sheet of fiber wallboard—and what home workshop nowadays can get along without having a supply always on hand? Be sure to smooth the edges with sandpaper.

To mount the picture, lay it on the wallboard, three-ply wood or cardboard mount so that the lower margin is slightly larger than the upper. Measure to make sure the side margins will be of equal width, and with light pencil lines mark the placing of the corners on the mount.

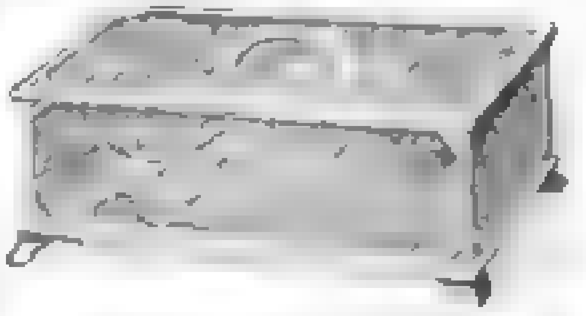
Set the picture face down on a clean newspaper and with a small brush or the tip of the finger apply library paste. Work from the center to the outside as rapidly as possible, keeping the whole moist. Lift the picture from the paper and lay it paste side down, on the mount, keeping the corners within the penciled lines. Stroke from the center to the outside with a very slight pressure. Be sure the edges and the corners are pasted securely.



A gesso-decorated sconce in old gold

Next, pencil the outlines of the border design. It is well to have a raised portion around the outside of mount, following the outer edge. The width of this depends upon the size of the mount, usually not more than ½ or less than ¼ in. There should be a raised portion around the picture as well. This should go partly over surface of picture and partly beyond it on the mount, and should be same width or, better still, narrower than the outer border. The rest of the design may be original, or suitable designs be traced with carbon paper from artistic printed matter.

After the design has been sketched on the mount, give the whole, picture and all, not forgetting the edge of the mount, a coat of clear (transparent) shellac or white varnish. The shellac dries more rapidly, so that within a few minutes after its application you can start the gesso work. (Continued on page 87)



A wooden jewel casket ornamented with gesso; finished in silver and blue polychrome

The Home Workshop

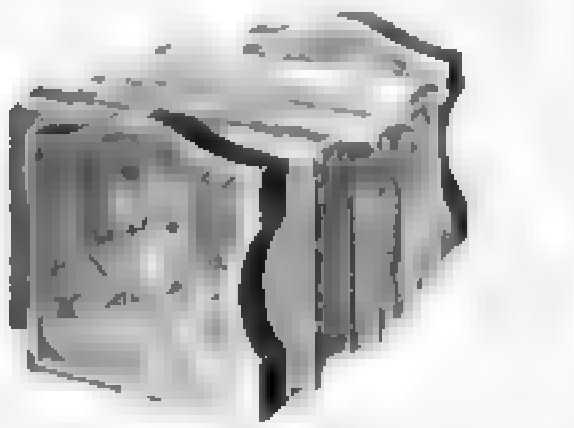
Simple Handicraft Modeling

Continued from page 86

The gesso should be a smooth paste, thin enough to drip from the end of a brush, and at the same time thick enough, so that it spreads very little when dropped. Apply it with a fine pointed camel's hair brush, outlining the design. If the raised portions are large, fill them with full brush loads. This is not done as if one were brushing on paint, but by a sort of "touch and lift" process called stippling. If the raised portion is not high enough after the first application, go over it a second time. Keep the surface as smooth as possible.

If a mistake is made, wipe away the gesso while yet soft with a damp cloth, or scrape it off if hard. Fine sandpaper may be used when an outer edge is rough or the corners are too pointed.

When the raised portions have set for three-quarters of an hour, the background may be put in. If wood has been used as a mount, it is not necessary to put on a background of the gesso unless you so desire, but wallboard or cardboard usually looks better if it is given a thin coating.



A pair of wooden book ends with a sailing ship motif artistically worked out in gesso

To do this, brush on a coat about 1/8 in. thick between the raised areas.

By the time the gesso has been applied to the entire background, the part first covered will be ready to work upon. Take a stiff 3/4-in. bristle brush, either round or flat, and with a slightly curved motion touch the brush to the background and then lift it clear. Do this rapidly — down, up, down, up — over the entire background. Then let the mount or decorated piece dry twenty-four hours, or at least overnight.

Ordinary gold paint was used in finishing the mount shown on page 86. It was applied to the entire surface of the natural color gesso design and background alike. Over the gold, when thoroughly dry, was brushed a little dark green oil paint mixed with turpentine to make a weak color. A clean dry cloth was passed over the surface at once, and this produced the effect of making the gold look slightly tarnished.

Next, a thin coat of brown, mixed in the same proportions as the green, was applied to all the low places in the design. Again a cloth was used to wipe off the surplus color. This gave an antique appearance. The raised parts and the picture were finally shellacked and polished with floor wax. (Continued on page 88)

Simple Handicraft Modeling

Bronzing powder in any hue mixed with bronzing liquid may be used for the initial color, and, when thoroughly dry, another color may be run over the first. A dry cloth wiped over this before the last color is dry takes some of it off and exposes the under color at various places, thus giving a polychromed effect.

Gesso may be applied to articles made of wood, glass, metal, paper, cardboard, papier mache, plaster of Paris, modeling clay or leather. With commercial gesso, it usually is safer to give to glossy surfaces, such as glassware and china, a preliminary thin coat of glue or glue size, although the two formulas given below will stick to almost anything, provided only the best grade of liquid glue is used.

If gesso novelties are made in any quantity, as in schools, the coloring can be done most quickly with the aid of small garden sprays.

Polychroming by the spraying method was described in an article on page 104 of the September, 1925, issue of the POPULAR SCIENCE MONTHLY.

Gesso Work in a Nutshell

Mixing the Gesso—First formula. Into 1½ cups of whiting pour 1 gill (6 tablespoons) of the best obtainable liquid glue, 3 teaspoons of linseed oil, and 1 teaspoon of varnish. Mix slowly for several minutes. If the mixture appears too thick, thin with water; if too thin, thicken with whiting. Second formula: Mix 10 tablespoons of whiting with water to a thick cream and add 6 tablespoons of liquid glue. Then mix in another dish 1 tablespoon of clear varnish with 4 tablespoons linseed oil. Stir the latter into the former and boil the mixture for 10 minutes in a double boiler. Both types of gesso may be applied cold and will not harden if kept in a closely corked jar.

Preparing the Background—It may be left plain, to be painted or bronzed after the gesso ornamentation has been applied, stained (if wood) with wood dye or tube paints diluted with turpentine, covered thinly with gesso and left smooth, or stippled, or marked while fresh with vertical and horizontal indentations to represent basket weaving.

Applying the Gesso—For a smooth surface, spread with palette or paring knife, dipping the blade into water and going over the work a second time. For haphazard patterns, especially desirable on articles that are to be polychromed, apply moderately thick, covering only a small surface at a time, and give a scrolled or lined effect with the point of the knife, or stipple the surface with a stiff brush. For more formal decorations, draw the design on the background and apply the gesso with a small brush, or use confectioner's icing tools or a stiff paper cone.

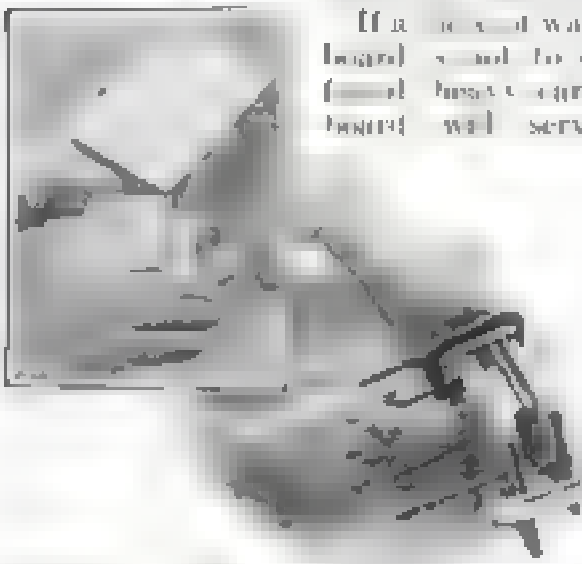
Finishing the Work—For a polychrome effect, gild with bronzing powder and banana oil. Roman or green gold, silver, or other colors, and when dry, paint with artist's oil colors, thinned with turpentine, rubbing off the surplus colors and blending the surface artistically with a clean cloth. A protective coat of shellac, flat or gloss varnish, or wax may be added. For an antique effect, dust the work lightly with rotten stone. The polychrome process also can be reversed by painting the surface first and then topping off lightly with rather dry bronzing colors. For colored finishes other than polychrome, use enamel, oilpaint, flat wall paint, poster or water colors. Protect the two last named with transparent shellac. Gesso also can be colored before application by mixing bronzing powders or dry colors with the paste.

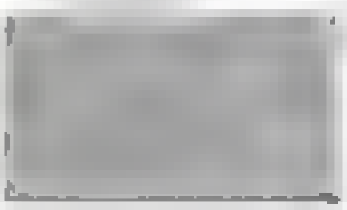
Imitating Wood Carvings with Fiber Wallboard

By Ernest Bade, Ph.D.

ORDINARY fiber wallboard may be used under certain conditions to imitate wood carvings, especially in the preparation of decorative panels for small doors, cupboards, chests, and miscellaneous furniture.

If a [illegible] wallboard [illegible] to be found, heavy cardboard will serve.





Well soaked wallboard is pressed in [illegible] and allowed to dry

Thinner cardboard may even be used, but several thicknesses should be soaked in water and glued together.

A mold of some kind is essential. This is not hard to obtain, as many types will be found around the house. Pressed glass or ornamental metal articles are the most serviceable. If a glass mold is to be used, the glass should be thick enough to resist a certain amount of pressure.

Soak the wallboard or cardboard in water for several hours or overnight until the material has swollen and become soft.

Set the mold, if it is small, on a heavy board and place on it the soaked stock in such a way that the design comes in the center of the swollen cardboard. Cover with a thick piece of wood and use a number of clamps to press the soft material into the mold. Tighten the clamps as much as possible and leave the whole until the next day.

The pressed panels may be used for decorating chests, cabinets, and small pieces of furniture

The design will be found firmly imbedded in the wallboard, and it can be used like a commercial pressed wood carving after it has become thoroughly dry. It should be well protected with varnish stain or other suitable finish.

Connecting a Lamp Cord to an Electric Socket

By GEORGE A. WILLOUGHBY

Supervisor of Electric Work, Arthur Hill Trade School, Saginaw, Mich

THERE are many times when you will find it necessary to repair a defective electric light extension or to make up a new one. Perhaps you may wish to construct a lamp or wire one up, or your wife or sister may cover a bed-lamp shade and expect you to put a light in it and connect it to the nearest outlet.

When doing any of these jobs, in fact when one makes any electrical connection with cord or fixture wire, it is essential that the work be done in a way to insure satisfactory results and to guard against possible trouble in the future.

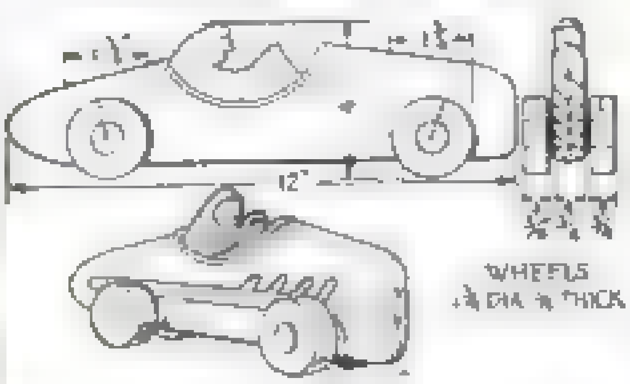
The four essential steps in connecting an electric lamp cord either to socket or to plug

One of the most satisfactory methods of "skinning" the wire and making connections of this kind is illustrated in the accompanying sketches.

With a pocket-knife or other blade held at an angle, as when sharpening a lead pencil, remove outer braid covering from the cord to provide for making the connection. Then carefully remove the outer braided covering for a short distance further back, without cutting the rubber beneath, twist the strands of wire tightly, and tie an Underwriters knot as described in last month's article.

Loosen the terminal screws on the socket, bring one of the twisted wires around each screw in a clockwise direction and tighten the screws. With snips, pliers or the like, remove excess wire.

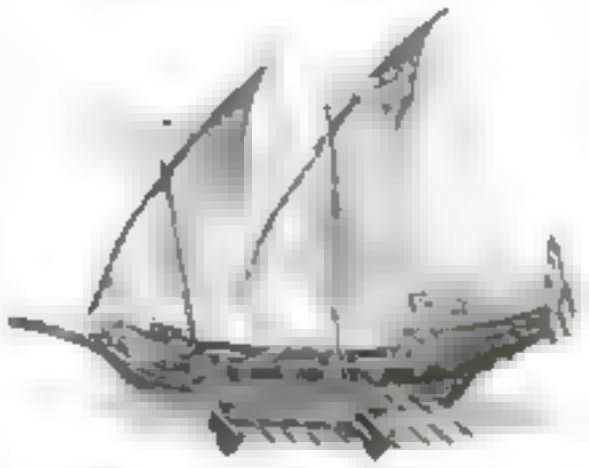
Whittling a Toy Racing Auto



MY YOUNG son has lots of fun playing with a toy racing auto I whittled from the end of a peach box. The wheels are sections cut from the wooden core of a roll of cash-register paper. They are pinned on axles made from ⅛-in. wooden dowels. HARRY P. BOTSFORD

The Home Workshop

A $100 Ship Model You Can Build for Less Than $3



IF YOU wish to build a duplicate of this strikingly picturesque pirate ship model, send 50 cents for Blueprints Nos. 44 and 45 on the list below. The model was designed especially for POPULAR SCIENCE MONTHLY by Capt. E. Armitage McCann, one of the leading authorities on ship models. The materials cost less than three dollars, yet the finished model is worth about $100 at present rates.

Complete List of Blueprints

ANY ONE of the Blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I enclose cents

No.	Title	Published	Price
1	Sewing Table	Feb	25c
2.	Smoking Cabinet	Mar.,	25c
3.	End Table	Apr., '22	25c
5.	Kitchen Cabinet	May, '22	25c
8.	Shaving Cabinet	June	25c
9.	Arbor Gate and Seats	July, '22	25c
10.	Porch Swing	Aug., '22	25c
11.	Bench and Tilt Table	Sept., '22	25c
12.	Electric Washer	Oct., '22	25c
13	Tea Wagon	Nov	25c
14	Christmas Toys	Dec	25c
15	Workshop Bench	Jan.	25c
16.	Inlaid Radio Cabinet	Feb.	25c
17	Cedar Chest	Mar	25c
18	Phone Table and Stool	Mar	25c
19.	Grandfather's Clock	Apr	25c
20	Flat Top Desk	Apr	25c
21	Colonial Desk	Apr	25c
22.	Cabinet and Desk	Apr	25c
23	Pergola Garage	May	25c
24	Gateleg Table	June	25c
25	Canoe Sailing Outfit	July	25c
26	Baby's Crib and Pen	Sept	25c
27	Kitchen Cabinet Table	Oct	25c
28	Pullman Play Table	Nov	25c
29.	Toy Tea Cart, etc	Dec	25c
30.	Tool Cabinet, etc	Jan	25c
31	Sewing Cabinet	Feb.	25c
32.	Chinese Game Table	Mar	25c
33	Dining Alcove	Apr	25c
34	Garden Trellises	May	25c
35	Simple Radio Cabinet	Oct	25c
36.	Rush Bottom Chair	Nov	25c
37	Simplified Bookcase	Dec	25c
38.	Sheraton Table	Jan.	25c
39	Salem Chest	Feb.	25c
40.	Desk in Sheraton Style	Mar	25c
41	One Tube Radio Set	May	25c
42	Three Stage Amplifier	June	25c
43.	Four Tube Receiver	July	25c
44	Ship Model: Hull	Feb.	25c
45	Ship Model: Details	Mar	25c

Name
(Please Print)
Street
City and State

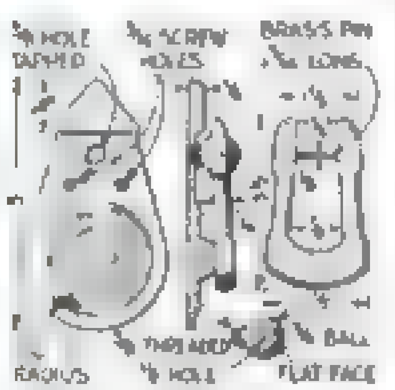
Scrap Brass Used in Making Ornamental Door Knockers

By RUFUS E. DEERING

TWO pieces of scrap brass picked up around a railroad yard were made into a knocker for our front door. A similar knocker can be fashioned by any one who has access to a small metal-working lathe from a piece of brass 1/8 by 3 by 5 in., another piece 1/8 by 1 1/2 by 3 1/2 in. and a small block or rod for the pivot ball.

The dimensions and the method of assembling are shown in the accompanying drawing. The knocker arm is sawed from the 1 1/2 by 3 1/2 in. piece with a hacksaw. It then is shaped, smoothed and finally polished with fine emery cloth.

The concentric rings on the back plate are turned on the lathe and the rest of the plate is shaped with a hacksaw and file. The pivot ball that supports the knocker arm is turned and threaded on the lathe and two sides afterward are well flattened with a file. After being assembled, the knocker is polished with fine emery and given a coat of clear lacquer to prevent its tarnishing.



Details of the back plate, the knocker, and the pivot

Ornamental Fence Protects Flowers and Shrubbery

TO PROTECT the planting about the base of a house, more especially when it is desired to achieve color effects with flowers, the fence illustrated below serves admirably. It also adds to the architectural effect, bringing the house in appearance a little closer to the ground. Any one at all handy with tools can build it.

The fence improves this house architecturally by making it appear to be closer to the ground

The railings are cut out of 1-in. stock, which is used double to break the grain. The pickets likewise are cut from 1-in. board. They extend through the top rail and the upper thickness of the bottom rail and are spaced about 3 in. apart. The end posts are built up of boards.

The curve of the fence was worked out on the ground and a pattern cut of wall board.—C. L. MELLER

Houses the Birds Really Like

(Continued from page 75

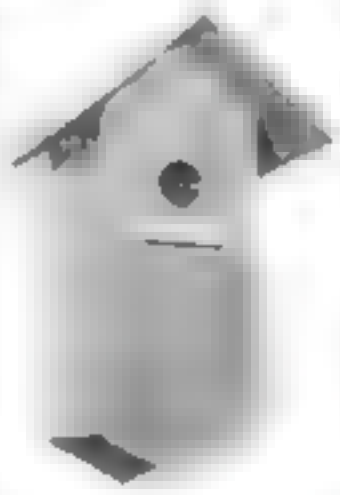


Fig. 4. A cleat or twig is nailed below the entrance

...rds frequenting your vicinity and decide on one or more you would like to attract.

The wren is a popular bird and adapts itself to most environments. See Fig. 3 for details of a wren house, and Fig. 3 for a method of hanging it from a building or post.

Stock ¾ in. thick is desirable for birdhouse construction. Thinner material will not withstand the weather as well. White pine reclaimed from boxes is excellent material, and cypress and yellow poplar make very durable houses.

Follow carefully the specifications for a given bird. Make good joints to keep out rain and drafts, and use plenty of box nails or fine, flat-head nails.

The entrance hole especially should be the right size, and it should slant upward for drainage. A cleat or twig (Fig. 4) may be nailed below the opening, to aid the birds in entering, but perches are not to be recommended as they give too much encouragement to English sparrows. Robin houses should be made with one or two sides entirely open.

Some means of cleaning the box is necessary. The removable bottom illustrated in Figs. 1 and 5 may be constructed easily. It requires no extra hardware, such as hinges and catches, does not affect the design, and allows ready and thorough cleaning. The front of the birdhouse sometimes is put on with screws so as to be removed for cleaning.

Ventilation and drainage are necessary—several ¼-in. holes under the eaves

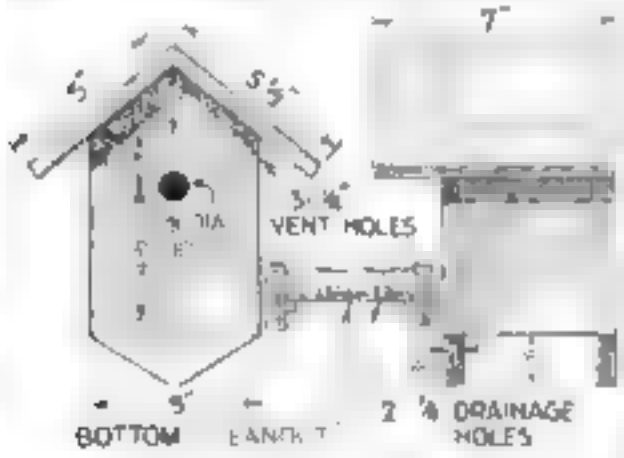


Fig. 5. Front and side elevations of an ideal wren house, and detail of removable bottom

and above the entrance, and one or two ¼-in. holes in the bottom.

Paint the outside of the houses for preservation and appearance. Dull colors in browns, grays, and greens are to be preferred. Do not paint the inside.

Hang the house according to the heights given in the table and do not have one house close to another. Place each in its natural surroundings where the house will be protected from the weather.

The Home Workshop

What My Home Workshop Has Done for Me

(Continued from page)

made some simple tool racks to hold them, keeping each tool in its allotted place at all times when it was not in actual use. During rainy weather, I kept them rolled in newspaper in a box I had converted into a chest.

How proud I was of their continued brightness and keenness! I never went to bed without polishing every tool with a piece of flannel that Mother gave me. So familiar was I with their exact positions in the racks that I could have picked out any particular tool in pitch darkness.

WHEN I was twelve years old, I had the following outfit:

Rip saw, crosscut saw, coping saw, smoothing plane, spokeshave, jack-knife, try square, marking gage, hammer, screwdriver, awl, rule, bitstock, four bits, dividers, two chisels, two gouges, pliers, cabinet file, rat-tail file, oilstone, slipstone, oilcan, and packing-box bench.

A little later I had saved up enough money, by making and selling birdhouses, to purchase lumber for making a simple bench, which Dad planned and helped me put together. This was equipped with a cheap but serviceable vise, homemade except for the screw, which cost 60 cents.

Along about this time we moved to another town, and my father quit carpentry to try his hand at violin-making and the repairing of stringed instruments. He fitted up a shop in a large downstairs room of the house.

It was my great delight to sit around outside of school-hours and watch him peel the beautiful spruce shavings with a gouge, or string up and test his latest "fiddles," and to hear noted virtuosos, traveling through, exclaim over the instruments as they wielded an airy bow and made the old home-shop reverberate with the thrill of their wonderful music.

By this time, my father had enough confidence in my ability to handle tools to allow me to help him with some of the simple repair work on violins, guitars, and mandolins, for which, I think, he paid me rather too liberally, as I look back and recall that I was only thirteen years old.

BUT, really, I think I was prouder yet when one day, after I had fixed a sticking kitchen door for Mother, Father said to her in my presence: "He did that job as well as I could have done it myself. Hereafter he'll have to be your little carpenter, Mother."

That night in my sleep I was whacking nails, ripping a saw, and whistling a plane all over the house. I think I must have done enough work to have renovated and reconditioned forty such houses as ours!

By the time I was seventeen I had, with Father's aid, made several violins, mandolins, and guitars, which were sold at a good figure. The special tools required for the work, even to the clamps, I was able to make myself.

One of my mandolins fell into the hands of the president of (Continued on page 95)

What My Home Workshop Has Done for Me

(Continued from page 94)

a company that manufactured a line of mandolins, guitars, banjos, and music cabinets, and it so pleased him that I was proffered a position as pearl inlayer and decorator in the factory.

I ACCEPTED and went to work. During the three years I spent with these people, I did not forget nor neglect my little home workshop. Every spare moment, especially in the cold evenings of late fall and winter and early spring, was put in either building furniture or making some youthful experimental device.

The greatest drawback in all this glorious fun with tools was the difficulty of getting lumber. The same bugbear faces most home-hobby craftsmen today.

The solution I worked out as a boy will serve quite as well in these times; in fact, I am still using it. It is this: Get cuttings (short lengths) of the kind of wood you want by seeing the foreman of some local manufacturing plant at long that wood in its product. Such plants always have a good deal of comparatively short pieces of board that are quite useless to them. They will give away the waste or sell cheaply, yet it will work in fine around the home workshop.

Often, too, neighbors will be glad to let one have old walnut and mahogany organ cases and bandstands, which provide the finest of cabinet woods for new pieces.

Designs for many of the articles that I made out of wood were found in magazines. As I loved to write and had already contributed quite a number of juvenile stories to various publications, I naturally got the idea of devising new wooden creations myself, making working drawings of these, preparing a written description, and trying to sell them.

THEY found a ready market. It did me good to think that my work at my home bench was carrying on and bringing an equal joy to other amateur woodworkers all over the country. I received scores of letters, as far away as Alaska, New Zealand, and South Africa, from enthusiastic and curious readers of these printed articles.

In later years, my home workshop led me into a position as furniture inspector for the War Department of the United States Government, with opportunity for rich experience, then into my present vocation of teaching manual training to public school boys, at which I have been engaged, with even greater rewards in experience, for the last twelve years. And during this period I have had the pleasure of writing and illustrating two exclusively handicraft books and of patenting seven inventions, the models of which were all made at my dear old bench.

A RESTORATIVE glaze for removing marks from varnished furniture may be made by mixing 1 part fluid extract of benzoin and 8 parts French varnish in 12 parts high proof denatured alcohol.

The Home Workshop

Secrets of Varnishing

(Continued from page 95)

of turpentine and the brush bristles are submerged, although they are off the bottom where the dirt settles one inch or so.

"Just before you use the brush, Dan," I explained, "swing it quickly downward to throw out any excess turpentine.

"The next factor is a tack rag. Take a clean piece of cotton cloth—old sheeting is ideal—about eighteen inches square. Get rid of any loose ravelings and then wring out the cloth in water as dry as can be. Pour on a little varnish, fold the edges of the cloth inward, and wring as dry as possible, changing the foldings several times. The varnish will quickly enter the cloth and force the water out, and when the cloth is allowed to dry for five minutes, it will be ready for use in wiping off any dust the brush may have left in corners or moldings. As soon as you get through using it, put the cloth in this old coffee can, and cover to prevent its drying and hardening.

"FOR the varnishing I prefer a high grade of floor varnish, since it is tough, long-lived, and dries hard enough to rub or polish perfectly. If sat upon, it is not apt to leave a cloth print, as do some cabinet varnishes.

"Since the top of your table and the mirror frame are the most important parts from the standpoint of finish, we will varnish them first. They are also easiest to clean. It is almost impossible to get parts such as the table frame perfectly clean, especially around the edges of the moldings and turned portions.

In varnishing the mirror, a start was made in a corner. After working halfway back the length of the side, a start was made from the opposite corner, working toward the fresh varnish. Notice in the photos on page 72 how the brush is held between the thumb and the first and second fingers very lightly, so as to make all strokes finger strokes and not wrist or arm movements.

Little pressure is used on the soft *flick* bristles. They hardly bend at all, and a good varnisher lays on with as few strokes as possible in order that the varnish may flow out and level itself quickly. The last stroke is a "tipping off" to remove bubbles or traces of brush marks.

THE outside of the mirror frame molding was left to the last and then finished as illustrated in connection with varnishing the edge of the table. The stroke is made from the center to the edge of the work.

For flat work, cut across both ends. Then flow out the varnish from the center toward each end, finishing with a "tipping off" stroke the full length of the work with no pressure whatever on the bristles. Cut off the edge as shown in the upper left-hand illustration on page 72.

"The next thing," I told Dan, "is one of the tricks of the trade. You see these little applicator rods—as they are called in the drugstore. They are simply small wooden sticks on which we fasten a button of fatty or

(Continued on page 98)

The Home Workshop

Secrets of Varnishing

(Continued from page 96)

'burnt' varnish. Moisten the fingers and roll the varnish into a small ball as large as a shoe button. Use this stick to pick out little specks of dirt before the varnish sets. This will save much hard work in the rubbing, and will also leave the varnish clean. Merely touch the lint or specks, which can be lifted out, and the varnish will flow in to fill up the hole."

The flat work was set up on a panel rack to dry for from three to five days. The table legs then were varnished upside down as far as the drawer frame rails. The frame was turned up and finished.

It is essential to brush from the center of the square face of legs and posts toward the edges, or sags will develop.

If the finish in any case does not happen to be dark enough, a coat of walnut varnish stain may be used as a second coat. The last coat should always be clear varnish (free of color).

This is how the old mirror and the table looked when Dan had refinished them

The first rubbing of a varnish coat is done with 6-0 sandpaper of the wet-or-dry type. It differs from ordinary sandpaper in that water can be used freely with it. The kitchen sandpaper previously mentioned is of this variety.

"Dip the paper into a pail of water," I explained to Dan, "and rub lightly across the edges of the work first. Then sprinkle water on freely and use a sanding stroke, rubbing the full length of the panel or other flat surface. This method will enable you quickly to cut down the work ready for the pumice. I would not attempt pumice rubbing, though, until you have laid on three or four coats of varnish. The first two should have the gloss just 'cuffed off' with the split paper so as to avoid cutting through the color.

"Test the quality of your rubbing by striking off the rubbing sludge quickly with the fleshy (Continued on page 98)

The Home Workshop

Secrets of Varnishing

part of the thumb being careful to draw in a straight line lengthwise of the work.

Wash off carefully, dry with a water-soaked chamois skin, wring as dry as possible, and inspect for incomplete rubbing and the presence of nibs or dust specks. Never use a perfectly dry chamois; to do so will mean scratches in your work. Be careful to draw the chamois skin only in the direction of the rubbing, or cross scratches will result.

When you come to the last coat or two, you will have to carry the rubbing a step further. Sprinkle the work freely with water, follow with sifted FFF pumice stone put on with a sugar sifter, dip a hard one-half or one-inch felt rubbing pad in the water pail, and proceed to rub thoroughly and carefully.

"BE VERY careful not to cut any edge while at this as this is always the mark of the amateur. You will understand now why I was so careful to have you round all the edges when sanding the fresh wood.

Wash off when you think the work has been rubbed enough, dry with two chamois passes, and spot rub lightly where necessary. Finally sponge with clean water, rinse off the rubbing pad and supply water-rub a minute or two to be sure that a fine clean surface free from scratches or rubbing marks results.

"For a final gentle use a heavy piece of cotton flannel dipped in water and sprinkled with pumice stone. Work as with a shoe polishing cloth. Watch carefully for this method cuts very fast.

For beads and moldings not reached with the cloth or pad, use a fine rubbing brush dipped in water and sprinkled with pumice as if you were brushing your shoes. Then clean off. Dorothy's work with water and use sponge and rubbing brush to remove all traces of pumice. Finally dry the work.

When the last coat of varnish had been rubbed, Dan laid a blanket on a bench top, placed the tabletop face down, put the hinges back in place, fastened the frame to the top and then cleaned up the whole job with a clean cloth or two and a good lemon oil furniture polish.

"There was no question about the appeals of the bench. Dan had two ready fine pieces to take home to his mother. Just turn back to page 97 and look at them!"

This is the conclusion of two articles on refinishing furniture. The first article appeared in the March issue, copies of which can be obtained, so long as the supply lasts, for 25 cents each, by writing to the Subscription Department of POPULAR SCIENCE MONTHLY. Another article by Mr. Wuring will appear in an early issue.

SMALL spiral springs sometimes are needed for repairing door locks and catches. When steel wire for forming the necessary springs has not been at hand, I have found that a steel shaving from a lathe or drill press often will serve reasonably well as a substitute. RUSSELL W. FOWLER.

The Shipshape Home

Spring Painting

What Every Home-Owner Should Know about It

By Berton Elliot

Painting and Decorating Expert

THAT there is any great degree of science in house-painting is not usually appreciated by the casual observer. He sees only a bucket of paint, a brush and ladder at hand with which to overalls with a useless right arm—and straightway thinks of painting as an occupation in which very little technical knowledge is required.

As a matter of fact, while anyone can brush paint onto a surface after a fashion, the good painter and, of course, the home-owner who wishes to make a genuinely satisfactory job of what painting he undertakes, must have a wide knowledge of painting materials, methods and requirements.

Paint plays an important part in keeping any house shipshape. In this article Mr. Elliot gives you the advantage of many years experience, for he is superintendent of the decorative department of a large paint manufacturer and a well known expert and writer on painting and decorating

He must know the absorption power of various woods, the proper preparation of any surface, what unusual conditions are present that will affect the results and how to meet them. He must know whether his materials are working right and what to do if they are not, and how long one coat should stand before applying another.

Good results in exterior house-painting, as the experienced painter does it, are a matter of scientific certainty, not haphazard chance. There are certain fundamental principles of painting. It is their observance that solves the mechanical problems existing in any particular case.

Broadly speaking, results in exterior painting depend upon the following three factors, providing high-grade materials are used:

(Continued on page 108)

The Ship-Shape Home

Your Spring Painting

1. Proper condition of the surface.
2. Favorable weather conditions.
3. Correct application of the paint.

Too much stress cannot be laid on the condition of the surface. It should be free from moisture, which is one of the worst enemies of paint. When present in the wood before the paint is applied, moisture is bound to escape somehow and the paint film, being elastic, expands into blisters. Siding or clapboards should be thoroughly dry.

PAINTING never should be done before plaster or wet basements have dried out, as the moisture is apt to force its way through the siding and blister the paint, even though the siding was thoroughly seasoned when put on. Painting also should be avoided where fresh mortar beds are in close proximity, on account of the tendency of the oil in the paint to absorb the moisture and fumes from the lime.

The surface should be free from dirt; loose dirt should be brushed off. Particular care should be taken to scrape off any mud that may be caked on the wood, as it is likely to pull loose later on, taking the paint with it.

On new work, all knots and pitchy resinous places should be sealed over with a brush coat of shellac shortly before the application of the first coat of paint, to prevent the pitch coming through the paint later.

If the building has been previously painted, all old, loose paint should be removed with a wire brush or scraper. Any blisters present from a previous painting should be broken and scraped off. Where sections of the surface have blistered and peeled very badly, it may be necessary to burn off the old coating with a painter's torch.

If there are any places where grease or oil has been spattered or spilled, they should be wiped thoroughly with a cloth saturated with gasoline, benzine, or turpentine, to cut the grease.

CRACKS and nail-holes should be puttied *after* the priming coat. Otherwise the oil from the putty will penetrate into the bare wood, allowing the putty to dry up, crumble, and come out.

Painting should not be done under the direct rays of the summer sun, which may cause blistering. Generally painting can be done so as to "follow the shade" around a house.

Never paint during or following a rain, heavy dew or frost, in damp, foggy atmosphere, or when rain is threatening. Neither attempt it in freezing weather. If the paint freezes before drying, the appearance of the job is ruined, and it is not very satisfactory even if painted over.

Seasons of the year when bugs, gnats, flies, and insects are prevalent are not desirable for painting, as they stick in the paint more or less and spoil its appearance, although certain substances, such as oil of citronella, can be added to the paint to keep the (Continued on page 101)

The Shipshape Home

Your Spring Painting

(Continued from page 100)

inserts away. To obtain good results from any paint, it must be thoroughly mixed. Otherwise the heavy pigment will go to the bottom and the top part of the paint will be too thin to give good results. A container of paint should be stirred to a uniform consistency *immediately before* and at intervals during application.

Stirring round and round does little good. A flat paddle should be used, starting with the end of the paddle at the very bottom and bringing it up through the paint with a turning, twisting motion.

Exterior paint should be applied with a brush scant-full; it must be brushed well into the surface and spread into a thin, uniform coat. It is better to have paint brushed out too thin than flowed on in a thick, heavy coat, although the latter may look better temporarily. Too heavy a coating does not dry thoroughly and is likely to crack and prevent the surface from ever being properly repainted unless all the heavy undercoats are burned off.

The first or priming coat over new wood should carry a generous amount of raw linseed oil and turpentine. The linseed oil is required to satisfy the absorption demand of the wood and still leave sufficient oil in the paint to make an elastic film that will not powder and chalk off. Turpentine is needed to assist in penetration. A soft, porous wood such as cedar or redwood siding, does not require so much turpentine. The harder and more resinous woods, such as yellow pine, require more turpentine.

The first coat over previously painted surfaces should be reduced to a fairly thin consistency with raw linseed oil and turpentine, to insure penetration clear through the old coating into the wood. The harder and more impervious the previous coating, the more need for turpentine.

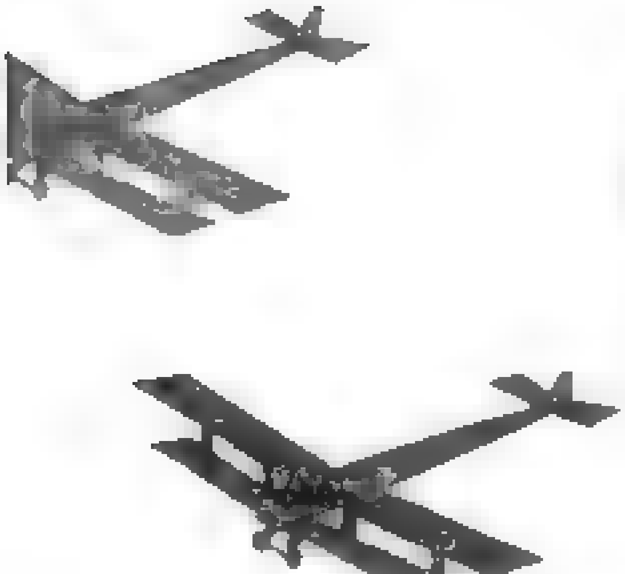
For second coat work over new wood, use considerable oil and turpentine, as the first coat never fully satisfies the absorption demands of the wood. The turpentine also tends to cut the gloss sufficiently to enable the following coat to adhere tenaciously.

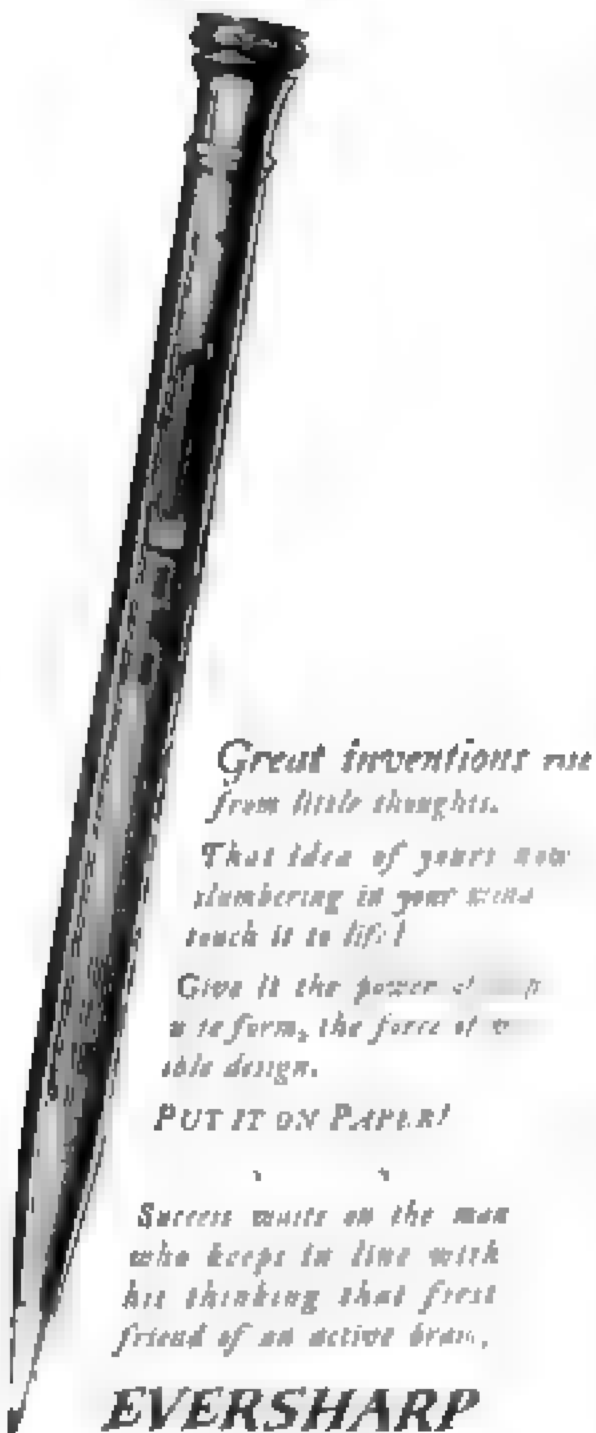
(Continued on page

Dollars for Ideas

IN KEEPING your home shipshape, you often hit upon ingenious time-saving, labor-saving and money-saving ideas.

If you will describe, in not more than 200 words, each of your ingenious keeping-the-home-shipshape methods, we will pay $2 for every one published. Include a pencil sketch or photograph to illustrate the idea, if possible, and address your letter to the Home Workshop Editor, Popular Science Monthly, 250 Fourth avenue, New York City.





Your Spring Painting

(Continued from page 1..)

The second coat over previously painted surfaces, and third coat over new wood, should all be full bodied coats with an adequate amount of oil to incorporate properly with the pigment and give satisfactory working and covering properties. Prepared paint is usually supplied in a consistency suitable for last coat work.

For a thoroughly satisfactory job on new work, three coats are generally required (priming coat and two additional coats). As a rule, it requires the second coat before the absorption demands are fully satisfied, and a third coat is necessary for adequate protection against the elements, as well as for maximum appearance. For repaint work two coats usually produce a first class job. If the surface is in excellent condition, one coat may answer.

EACH coat should be allowed to stand until thoroughly dry, but not until bone hard. As a rule from one week to ten days is a satisfactory length of time. Amateur painters often try to hurry the work unduly.

One small but often troublesome point might be mentioned here: a simple and satisfactory way to remove paint from window glass is to scrape it off with old safety razor blades. Regular blade holders for this purpose are sold in most paint stores. Paint and varnish remover or hot acid vinegar may be used to soften paint before scraping and wiping it off.

The most common troubles experienced in painting are peeling, blistering, scaling, spotting, perishing and loss of gloss. Any faulty job of painting may be due to inferior materials, but taken for granted that high grade materials are used, the following are the most common causes of poor results.

Peeling is what happens when the paint film breaks loose from the surface in rather large sections and curls up. The most common cause is moisture. Sappy or pitchy places in the wood that have not been sealed with shellac also frequently cause peeling.

WHEN the peeling occurs after a building has been painted several times, and the paint peels clear to the wood, the fault is undoubtedly in the first painting of the building. The original priming coat has not been clinging tenaciously to the wood, but has not heretofore broken loose and let go.

If the coats separate, and some of the first coats remain on the wood, the condition is generally termed scaling. Either the surface was not in fit condition to paint over—was not free from moisture at the time of painting—or insufficient oil and turpentine were used in the paint. Scaling is most frequently experienced in localities subject to fogs.

Blistering is generally caused by moisture seeking its way out from the inside. It is most prevalent with midsummer painting, as any moisture in the wood is vaporized quickly by the direct rays of the hot sun. It is *(Continued on page 1..)*

The Shipshape Home

Your Spring Painting

Continued from page ...

more common with dark colors than with light colors.

Spotting is the term used where patches of varying size appear after the paint has become dry. When the patches are lighter than the normal color or less glossy, the fault is generally too little oil in the paint. The more porous places in the wood absorb more oil, and there is not sufficient remaining in the paint to produce a uniformly glossy film over these places.

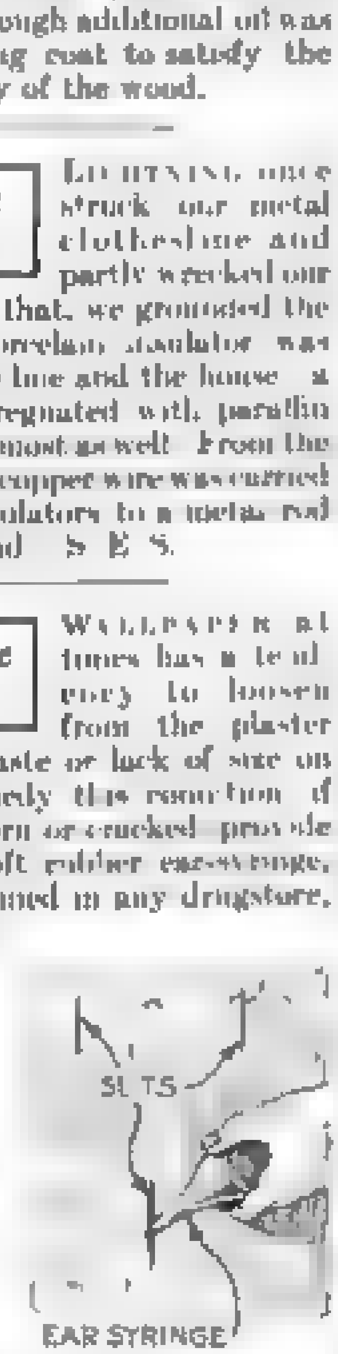
Rapid loss of gloss indicates that not sufficient oil was present to bind the pigment properly. Either the liquid and pigment contents of the paint were not balanced or not enough additional oil was used in the priming coat to satisfy the absorption capacity of the wood.

Grounding a Clothesline

Lightning once struck our metal clothesline and partly wrecked our back porch. After that, we grounded the line. A heavy porcelain insulator was placed between the line and the house—a wooden block impregnated with paraffin would have done almost as well. From the clothesline a heavy copper wire was carried down on small insulators to a metal rod driven in the ground.—S. E. S.

Pasting Loose Wallpaper

Wallpaper at times has a tendency to loosen from the plaster because of poor paste or lack of size on the wall. To remedy this condition, if the paper is not torn or cracked, provide yourself with a soft rubber ear-syringe, which can be obtained in any drugstore, and fill it with a good but rather thin paste.



Puncture the paper at the top of each loose section, insert the tube of the syringe in the small opening, and inject as much paste as necessary. The paste will flow down and can be spread by using a clothes brush or roller to squeegee the wallpaper in various directions. Use no more paste than is sufficient to do the work well.

This method is neater than loosening the paper and applying the paste with a brush.—H. J. Blake, M. D.

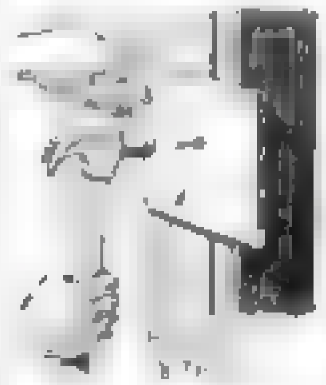
A Safety Nailing Pad

When one is not accustomed to using a hammer and is confronted with the necessity of driving nails into finely finished woodwork, such as picture molding, the trim around windows and doorways, and the like, there is often a feeling that the tool might slip and dent the wood badly. The more one fears (Continued on page 163)

The Shipshape Home

(Continued from page 103)

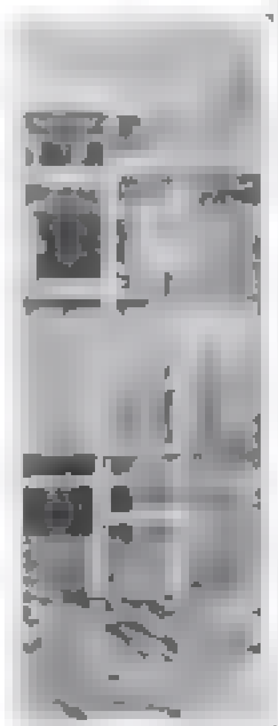
this, the more apt the hammer is to glance off the nail. But you needn't be alarmed if you use a safety pad made from an old piece of rubber or inner tube about 1/8 in. thick and 3 in. or more square. Punch a small hole in the center just large enough for a nail-head to pass through easily.



First start the nail into the casing or molding with a hammer. Then slip the safety pad over its head, and drive the nail into the wood until its head is even with the outer surface of the pad. Take off the pad and set the nail into the surface, concealing the hole with one of the fillers mentioned on page 85.—James E. Marion.

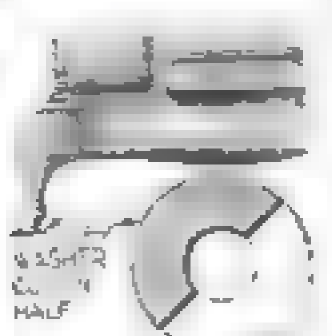
A Light Ladder for Odd Jobs

In doing small repair work about the house, it is often necessary to have a ladder that is longer than the household stepladder and shorter than the regulation extension ladder. The home mechanic, when he undertakes to make a ladder of this kind, often uses such heavy material that it is awkward to handle. A good way to make a light ladder of moderate length is to use long 1 by 2 in. strips, furring or shingle laths. Each side is composed of two pieces, the inner one being bent a trifle, as shown, when the crossbars are nailed on. It is also well to taper the ladder slightly from the bottom to the top.—R. M. S.



How to Protect Linoleum

Some types of oil and gas stoves and ranges are placed directly on linoleum floor coverings, with the result that the sharp feet sink in and seriously damage the surface. This can be prevented by placing half a large iron bolt washer under each leg as shown. Standard washers 1¼ to 1½ in. in diameter are suitable for stoves of different sizes. Either blacken the washers to match the stove, or paint to harmonize with the linoleum.—Frank Bentley.



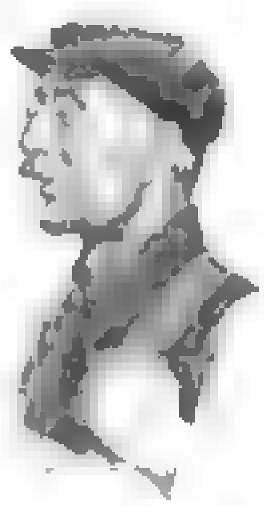
Better Shop Methods

Old Bill Says—

KEEP tool and cutter grinding wheels true at all costs, all of the time.

There is nothing that tries a man's patience more than having to grind a drill or other tool on a wheel that runs like an eccentric on a steam engine.

When polishing in a lathe with emery cloth, use a stick or block of wood to hold the abrasive.



Old Bill, machine shop foreman

Never try to measure work while the machine is running; this practice is the cause of many bad accidents.

There is no better place in the world for the use of brains than the machine shop.

Do you clean-up your machine when you are leaving it for the next fellow?

When you take a piece of work out of the lathe chuck, be sure to remove the chuck wrench.

Chatter on lathe work is caused frequently by using a dog too small for the job, an imperfect bearing at the point where the dog touches the drive plate, or a spindle too loose in the bearings; a job also may be too large or too heavy for the machine, in which case the next larger size lathe should be used.

Do you know that a large percentage of taps are broken for the simple reason that they become dull?

Facing Shoulders Accurately

SOME old timers, but few of the younger generation of mechanics, use the following simple method of making facing cuts to an accurate dimension from some point on the work previously faced, as in measuring the depth of a counterbore or the height of a shoulder.

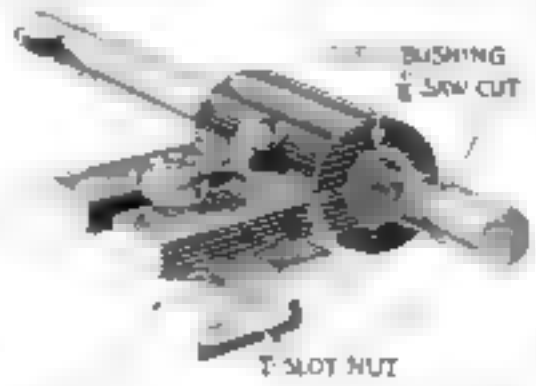
Lock the carriage, swing the compound to an angle of 30 deg., make a cut, and measure to the point already faced. Suppose the work is to be faced exactly .500 in. from a shoulder and the first measurement is .526 in.; feed the compound in .002 in. on the micrometer for each .001 in. to be removed from the face. In other words, the compound will be fed in .052 in. to remove the desired .026 in.

When the compound is set to an angle of 30 deg., its path as it is fed into the work forms a right triangle with an angle of 30 deg. between the side adjacent and the hypotenuse, and since the sine of 30 deg. equals one-half, each .001 in. fed in by the compound represents .0005 in. travel of the tool toward the work. This rule is applicable in many ways because of its accuracy.—B. B. SHEETS.

Better Shop Methods

Boring-Bar Holder Lessens Vibration on Lathe Work

FOR heavy boring jobs in big lathes, the type of boring-bar holders that are held in the toolpost are not always satisfactory because of the vibration. To overcome this defect a boring-bar holder of the design shown has proved satisfactory. The design is extremely



Because of its wide bearing surface, this boring bar holder stays rigid under heavy cuts

simple, but the construction is rigid and that is the important feature.

A pattern is made for the iron body and the casting is planed on the bottom. The hole for the bar is bored to accommodate the largest size bar used, smaller bars are held by means of steel bushings.

A T-slot nut, with a bolt, nut, and washer furnish the clamping arrangement for the holder, and the bar itself is locked securely in position with a single cap-screw. Shims are used to raise the bar up when necessary.—H. L. W.

Salvaging Worn Plugs and Caps with the Aid of Heat

PLUGS that have become worn in the threads (as at A) so that they are no longer tight, may be expanded and re-chased, or, in most cases, used as they are. The method is to insert a tapered mandrel, heat both, and cool the plug first. Caps may be treated the same way, except that the mandrel should be cooled. A hole through the plug and mandrel facilitates the separation of the parts when they are cool.—A. B. S.

Shop Tapers in Common Use

FOUR common tapers are in general use in machine shop work, one for taper pins and three for tool shanks and sockets and for machine spindles. Standard taper pin reamers are made with a taper of ¼ in. a foot. The Brown and Sharpe taper is made in 18 sizes with a mean taper of ½ in. a foot. The Morse taper is made in seven sizes and has a mean taper of ⅝ in. a foot. The Jarno taper is made in 20 sizes with a definite taper of .600 in. a foot for all sizes, so that a simple calculation will show the number for a given size.

Better Shop Methods

Speeds, Feeds—and Your Job

Continued from page 78

it would move past the point of the tool a distance equal to the circumference of the work. You had that in school, didn't you?"

"Yes," said Harvey. "It would be ," and he wrote down $4 \times 3.1416 = 12.5664$.

"Well," continued Grimes, "if you are running at fifty revolutions per minute you would get ' and he noted $50 \times 12.5664 = 628.32$ in. That would pass the point of the tool every minute. As there are twelve inches in a foot, we divide by twelve to get 52.36 *feet* in one minute. And this is the cutting speed in *feet per minute* because this is the number of feet of metal that pass the point of the tool in one minute."

If there were three pieces of work as in Fig. 1, Grimes went on to explain one 2 in. in diameter, running at 200 revolutions, another 4 in. in diameter, running 100 revolutions, and a third piece 8 in., at 50 revolutions, they

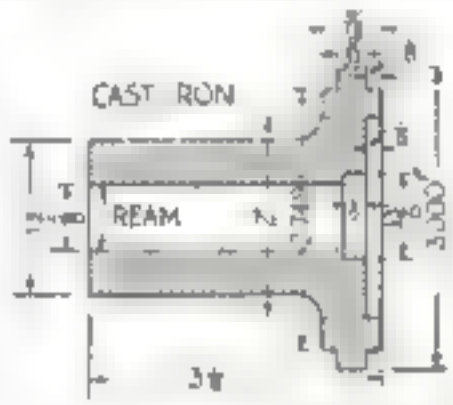


Figure 4. Grimes showed Harvey how to cut [illegible] time (from 2½ to 4½ minutes on this turret lathe job

would all have the same surface speed because

$$\left.\begin{array}{ll} \text{(A)} & \dfrac{2 \times 3.1416 \times 200}{12} \\ \text{(B)} & \dfrac{4 \times 3.1416 \times 100}{12} \\ \text{(C)} & \dfrac{8 \times 3.1416 \times 50}{12} \end{array}\right\} = 104.8 \text{ feet per min.}$$

If it is found safe by experiment to run the 2-in. piece at 200 revolutions when of yellow brass, a 4-in. piece could safely run at ½ of 200 = 100, or an 8-in. piece at ⅛ of 200 = 50.

"But how do you know what the right speed for anything should be. Harvey asked, "forty feet, fifty feet, two hundred feet? There's a big difference in metals."

"That is simply a matter of experiment based on what we know has been proved satisfactory. We know that in the majority of cases we can turn or bore cast-iron at fifty feet, yellow brass at one hundred and fifty feet, machine steel at sixty feet, brass castings at one hundred and twenty feet, bronze at from sixty to eighty feet, tool steel at from thirty-five to forty feet. All of these are subject to variations, but these speeds are usually safe. Of course, these speeds are on the assumption that a normal amount of stock is to be removed and not for very heavy cuts."

"Is this system," said Harvey, "near enough right so that you can figure how long it would take to do a job if you only have a blueprint in (Continued on page 108)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Better Shop Methods

Speeds, Feeds—and Your Job

(Continued from page 185)

front of you—before you see the work?"

"Of course it is," replied Grimes. "I use it every day to find out whether you men in the shop are getting all the production we should expect."

"Well, if that's so," Harvey asked, "how could you figure these castings that I've got to do tomorrow?" He pointed to a couple of boxes of castings like that shown in Fig. 4.

"Do you want me to figure it out and tell you how long it should take, and then see how near you can come to my figures?" asked Grimes.

"I wish you would. Then I can see just what I could gain if I knew how to do it myself."

"All right," said Grimes, "I'll tell you in the morning, after I have seen your tools set up on the machine."

"I don't see why you have to see the tools," was Harvey's quick comment. "You ought to know what we'll have."

"Yes, I know what you *ought* to use, but I don't know whether you will have a good set-up or not until I see it."

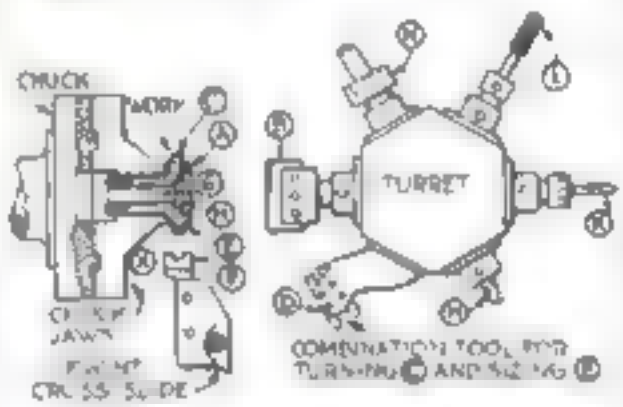


Fig. 5. How turret and cross slide tools were set up for finishing the iron casting shown in Fig. 4

"All right," said Harvey. "I'll call you when I'm ready."

The next day, with the turret lathe set up ready for this job, Harvey called Mr. Grimes, who made a sketch of the set-up as shown in Fig. 5 and went back to his office. He returned a little later and told Harvey he should be able to do one piece in about 4 min. 20 sec.

"How long does it take you?"

Harvey laughed. "I guess you missed it that time. It takes me over seven minutes, working hard."

"Well, let's see what's wrong," said Grimes. "Go ahead and make a few pieces while I watch."

Sure enough, by actual test it took 7½ min. to complete one piece.

"Now, look at my estimate, Harvey," (referring to Fig. 1) "and change your method to correspond. Increase your cutting speed for turning from forty to sixty revolutions and use a feed of ten instead of six thousandths. Then use your cross-slide tool to cut down the shoulders while turning. Increase the speed for drilling from two hundred sixty-four to three hundred twenty, and feed eight thousandths instead of six. Use hand feed for reaming instead of power."

After making these changes, the work was completed, much to Harvey's surprise, in 4¾ minutes, very close to estimated time.

(Continued on page 188)

(R) This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Speeds, Feeds—and Your Job

(Continued from page 108)

"I'll have to take my hat off to you, Mr. Grimes. I'm a convert to scientific methods hereafter, and I wish you would show me how to figure it out."

"If you would care to come up to my house a couple of evenings a week, I'll be glad to," said Grimes. So the arrangement was made, and Harvey came up for the first lesson the same evening.

"Is high speed and fine feed better than slow speed and coarse feed?" was Harvey's first question.

"You've struck a place where good judgment is required," was the answer, "and to give you an idea of it, we must know something of the requirements of the work. For example consider whether it is a roughing or a finishing cut. If a roughing cut, we have to remove considerable stock, leaving a few thousandths only for final finishing. And, of course a finishing cut requires greater accuracy. The following figures you can put in your notebook for reference as a guide in deciding on the feeds and speeds under normal conditions."

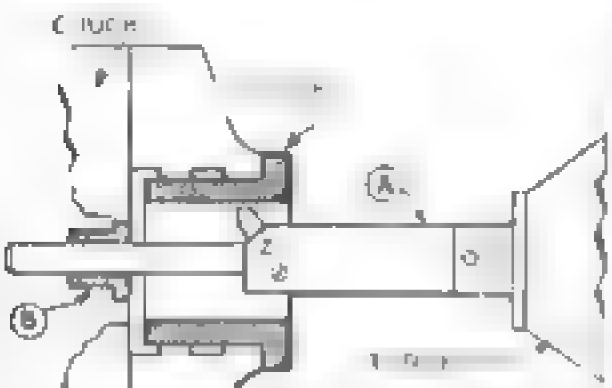


Fig. 6. Speed in boring depends largely upon the type of tool used on the job

"What are normal conditions?" interrupted Harvey.

"For cast iron a normal condition would be represented by good quality iron, free from sand and scale, and with a finish allowance of from one sixteenth to three thirty-seconds of an inch on a side. For brass or bronze, about the same.

"For a roughing cut we normally should use a cutting speed of from fifty to sixty feet per minute for cast-iron, and a feed of from twenty to forty thousandths a revolution. If a roughing cut is followed at once by a finishing cut—and at the same setting—the finishing cut could run at from seventy-five to eighty feet per minute with a feed of from eight to twenty thousandths, depending on the shape of the tool, the quality of finish specified and the accuracy required. For some kinds of work, requiring only a commercial finish, a broad-nosed flat-ended tool can be used on cast-iron at an even coarser feed."

"That's all right for turning and facing, but what about boring operations, Mr. Grimes?"

"As a general thing, the size and rigidity of the boring tool determines the feed and speed that can be used with safety. A piloted boring bar like that at A in Fig. 6, having a pilot supported by a bushing (B) in the chuck (Continued on page 114)

NERVE EXHAUSTION

How Nerve Abuse Wrecks Health

by PAUL von BOECKMANN

Lecturer and Author of numerous books and treatises on Mental and Physical Energy, Respiration, Psychology and Nerve Culture

THERE is but one malady more terrible than Nerve Exhaustion, and that is its kin, Insanity. Only those who have passed through a siege of Nerve Exhaustion can understand the true meaning of this statement. No word is horrible enough to express it. At first, the victim is afraid he will die, and as it grips him deeper, he is afraid he will not die, so great is his mental torture. He becomes panic-stricken and irresolute. A sickening sensation of weakness and helplessness overcomes him. He becomes obsessed with the thought of self-destruction.

Nerve Exhaustion is due to nerve strain. There is no other cause for it. In men, Nerve Exhaustion can generally be traced to excesses and vices, although the strain of … and the worries of business … are often the chief factors. In women, Nerve Exhaustion is due mainly to … emotions. … Indeed, we are all under severe nerve strain because of the mile-a-minute life we are leading. And … is so strong as to be immune to this strain.

Nerve Exhaustion is not a malady that comes suddenly, yet its symptoms are unmistakable. It does not manifest itself in … twitching muscles and trembling hands. The majority of sufferers from nerves seem strong and healthy, and may have not a tremor in their body, yet *inwardly* their nerves are in a turmoil and are undermining their vital organs.

The symptoms of Nerve Exhaustion vary according to the individual characteristics, but the development is usually as follows: First Stage: Lack of energy and endurance; that tired feeling. Second Stage: Nervousness; sleeplessness; irritability; decline in sex force; loss of hair; nervous indigestion; sour stomach, gas in bowels, constipation; irregular heart; poor memory; lack of mental endurance; dizziness; headache; backache; neuritis; rheumatism and other pains. Third Stage: Serious mental disturbances; fear; undue worry; melancholia; dangerous organic disturbances; suicidal tendencies; and in extreme cases, insanity.

If only a few of the symptoms mentioned apply to you, especially those indicating mental disturbance, you may be sure that your nerves are at fault—that you have exhausted your Nerve Force.

Perhaps you have chased from doctor to doctor seeking relief for a mysterious "something the matter" with you. Each doctor tells you that there is nothing the matter with you; that every organ is perfect. But you know there is something the matter. You feel it and you act it. You are tired, listless, cannot sleep, cannot digest your food, and you have pains here and there. You are told you are "run down" and need a rest. Your doctor may prescribe a drug—a nerve stimulant or sedative. Leave nerve tonics alone. It is like making a tired horse run by towing him behind an automobile.

And don't be deceived into believing that some magic system of physical exercise can restore the nerves. It may develop your muscle but it does so at the expense of the nerves, as thousands of athletes have learned through bitter experience.

The cure of weak and deranged nerves must have for its basis an understanding of how the nerves are affected by various nerve strains. It demands an understanding … Through the application of this knowledge the most aggravated case of Nerve Exhaustion can be corrected.

I have made a life study of the mental and physical characteristics of nervous people. I have treated more cases of Nerve Exhaustion during the past 25 years than any other man in the world (over 100,000 cases).

The result of this vast experience is embodied in a 64-page book on the "Nerve Force." This book … how to care for the nerves and how to apply simple methods for their restoration. It includes important information on the application of deep breathing as a remedial agent. The cost of the book is only 25 cents (coin or stamps). Address Paul von Boeckmann, Studio …, 110 West 40th St., New York City.

This book will enable you to diagnose your trouble … The facts presented will prove a revelation to you … Your nerves are the most precious possession you have. Through them you experience all that makes life worth living; for to be dull-nerved means to be dull-brained, insensible to the higher phases of life—love, moral courage, ambition and temperament. The finer your brain is, the finer and more delicate is your nervous system, and the more imperative it is that you care for your nerves.

"Nerve Force" is not an advertisement of any treatment I may have to offer. This is proved by the fact that large corporations have bought and are buying this book from me by the hundreds and thousands for circulation among their employees—Efficiency. Physicians recommend the book to their patients—Health. Ministers recommend it from the pulpit—Nerve Control, Happiness. Never before has so great a mass of valuable information been presented in so few words. It will enable you to understand your Nerves, your Mind, your Emotions, and your Body. Over a million copies have been sold during the past fifteen years.

PAUL von BOECKMANN

… on Health, Psychology, … Hygiene, and kindred subjects … have been translated into … languages

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 4.

Speeds, Feeds—and Your Job

(Continued from page 108)

or faceplate, will take a feed of twenty thousandths a revolution, while another bar just like it but without the pilot and bushing support cannot be fed over ten or twelve thousandths.

"For brass castings, feeds are about the same as for cast-iron, but the speed is from two and a half to three times as fast, or from one hundred twenty to one hundred eighty feet a minute.

"BRONZE varies a great deal as to speed, depending on the alloy. It should be cut with a lubricant, and usually the rate varies from forty or fifty feet per minute for manganese or phosphor bronze up to eighty or ninety feet for the aluminum alloys, with feeds about the same as for cast-iron. Finishing speeds may be twenty-five percent higher and feeds finer to produce a high quality of finish.

"Well, I'd have to digest all this," said Harvey, "before I can use it, but I wish you would show me some short way of figuring out the right speed for a piece of work so I can get started right."

"I'll tell you a scheme," said Grimes, "that I use for figuring in my head. It's not quite accurate, but near enough for practical shop use. Instead of figuring the circumference of the work as I showed you, and then getting the proper number of revolutions to give a certain speed in feet per minute, just multiply the cutting speed you want by four and divide by the diameter of the work.

As an example, Grimes took a piece of cast iron 6 in. in diameter to be cut at 60 ft. a minute. Then

$$\frac{60 \times 4}{6} = 39\frac{1}{2} \text{ revolutions a minute.}$$

Or, if the cutting speed is needed when the work is running at a certain number of revolutions, divide the revolutions by 4 and multiply by the diameter. For example, in the case of work 8 in. in diameter running at 50 r.p.m.,

$$\frac{50 \times 8}{4} = 100 \text{ ft. cutting speed.}$$

Set down as a formula

C = cutting speed in feet per minute.
D = diameter of work.
R = revolutions per minute.

Then $R = \frac{C \times 4}{D}$

$$C = \frac{R \times D}{4}$$

"Why do you multiply or divide by four?" asked Harvey.

Mr. Grimes explained that that was simply because 3.1416 ÷ 12 = .262, which can be considered as approximately ¼ or ¼ for rough figuring. Instead of multiplying the diameter of the work by 3.1416 and dividing by 12, divide by 12 first, which gives the constant .262.

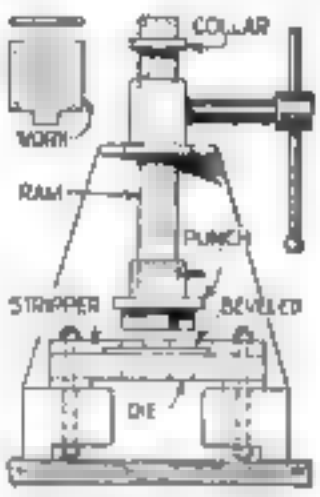
"Yes, I see it now," said Harvey. "It is easy to remember and easy to figure. I'm going to use it in the shop, and if I don't make 'Old Tom' sit up and take notice pretty soon, I'll miss my guess."

Grimes laughed as he bade the young man good-night, and said: "You must be looking for the foreman's job!"

Better Shop Methods

Arbor Press Used for Stamping Small Sheet Metal Parts

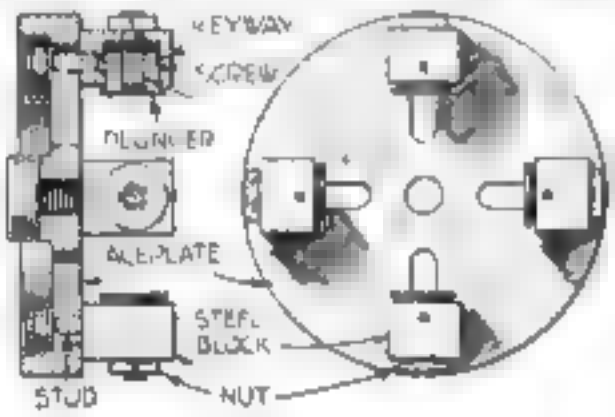
IN A SMALL shop with no stamping-press, a quantity of blanks of the shape illustrated was produced on an arbor-press. The punch was held on the arbor-press ram with a setscrew, and the die was bolted to the bed of the press. A collar attached to the top of the ram prevented the stripper from being damaged when the punch went through the stock. The punch was a close fit in the stripper which acted as a guide and the opening was beveled to make sure that the punch would enter without shearing.—CHAS. KUGLER.



How punch and die are set up in press

Four Jaws Convert Faceplate into Chuck for Lathe Work

FOR home mechanics, small shop owners and others who do not care to invest in a standard lathe chuck or who wish an extra chuck or two, the jaws illustrated will be found a satisfactory substitute when attached to a common faceplate. The steel block that forms the body of each jaw is bored for the plunger



Each jaw consists of a steel block, a cylindrical plunger, adjusting screw and stud

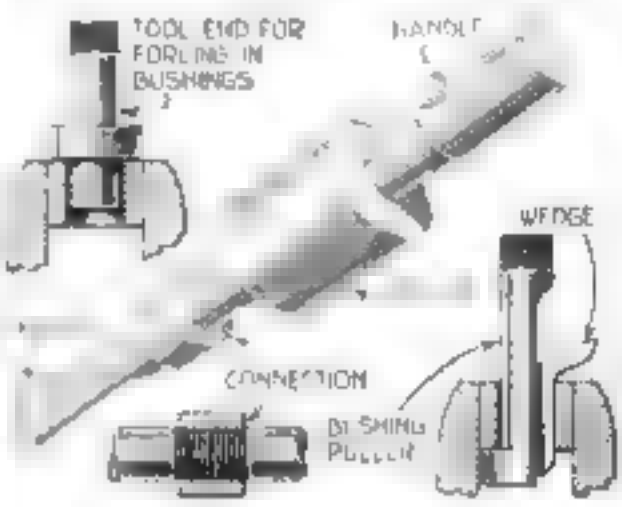
and drilled and tapped for a stud to hold it to the faceplate. A small screw is provided as shown to enter a keyway in the plunger; it prevents the latter from turning. The screw for operating the jaw is made with a shoulder to bear against the end of the bored hole in the square body, and has a square nut pinned to it at the outer end.—F. N. COAKLEY.

Cleaning a Gage Glass

OWING to the difficulty encountered in removing gage glasses to clean them, the engineer of a Florida ice plant merely places a cup with some muriatic acid in it under the bottom petcock and then quickly opens and closes the valve above. A vacuum is formed of sufficient strength to draw the acid vapors up into the glass, and they remove the coating. The cock then is left open to allow the condensed liquid to run back into the cup. If the glass is not perfectly clean after the first operation, the process is repeated.—J. C. WRIGHT

Tool for Removing Bushings Has Self-Contained Hammer

THE bushing remover illustrated is its own hammer. When a bushing is to be taken out, the hook is inserted in the hole and caught under the back of the bushing, where it is held by a wedge. The handle then is screwed in place and



This tool with different end pieces serves both for inserting and removing bushings

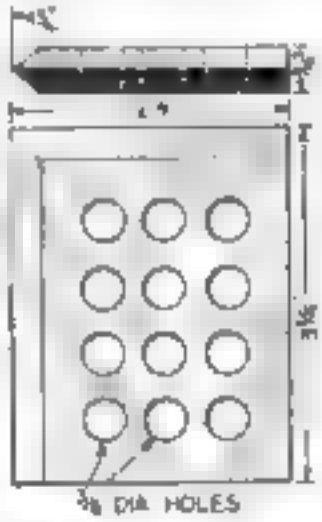
the driver, which is a free sliding fit on the shank of the handle, is worked back and forth like a hammer. The blows so directly are heavy enough to pull a small bushing.

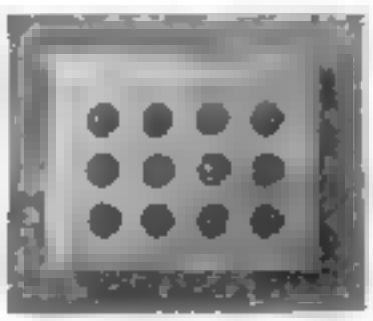
For inserting bushings a different type of end piece is made. It has a pilot to enter the hole and a shoulder to force the bushing into the frame.—A. L. Ehs.

A Square for Accurate Work

MACHINISTS and toolmakers will appreciate the small square illustrated. It has no blade to be sprung out of shape, and is convenient to use. The dimensions shown have proved to be about right for the usual run of work. The knurls provide a finger grip, and reduce the weight.

The square is hardened, ground, and lapped. The knife edge and tool to a flat about .010 in. across.—E. W.





This square cannot easily be damaged or rendered inaccurate. The dimensions indicated are well adapted to ordinary work

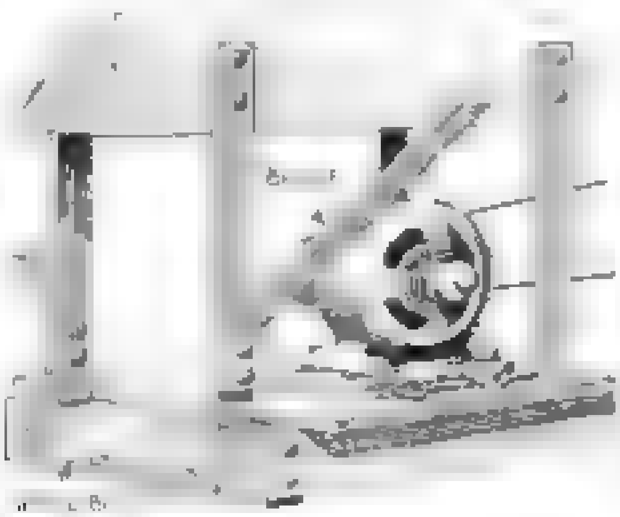
AN EXCELLENT dressing for leather belts can be made by compounding 1 lb. of beef tallow with ½ lb. of cod liver oil. Melt the tallow and allow it to cool to about blood heat. Then pour in the cod liver oil and stir until cool. If this mixture is applied to the belt occasionally it will keep it soft and pliable without injuring the leather in any way.—H. L.

Better Shop Methods

How to Suspend an Electric Motor from a Wooden Beam

A SUBSTANTIAL but inexpensive support for a motor used to drive a small line shaft may be made as shown below. It is attached to one of the members of the roof truss, or special timbers can be set up, according to local conditions.

Two hangers are made of flat iron heavy enough to support the load. Another piece of the same iron is bolted to



This method of suspension can be used for either small or fairly large line-shaft motors

the bottom of each hanger to support the timbers that support the motor platform.

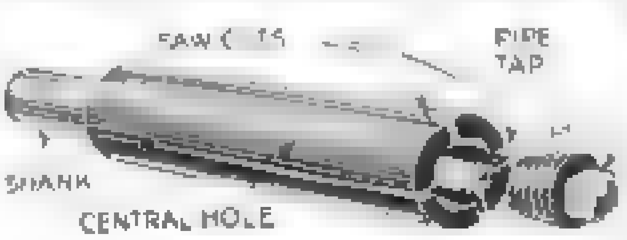
A space block is set between the vertical sides of the hangers and two bolts are passed through each bracket from one side to the other. Heavy planking is nailed across the timbers to serve as the platform.

Additional diagonal braces to take the pull of the belt should be provided when the motor is more than two horse power, but they are not usually necessary if the motor is light. This arrangement is also often a convenient one in home workshops where a line shaft is used. —W. L.

Pipe Plug Expands Lap

SO CHEAPLY and quickly made is the type of lap illustrated that a number of sizes can be prepared and kept on hand for jig bushings and various jobs requiring the lapping of holes.

The lap may be cast iron or brass. The outside diameter is made .005 in. less than the size of hole to be lapped. The central

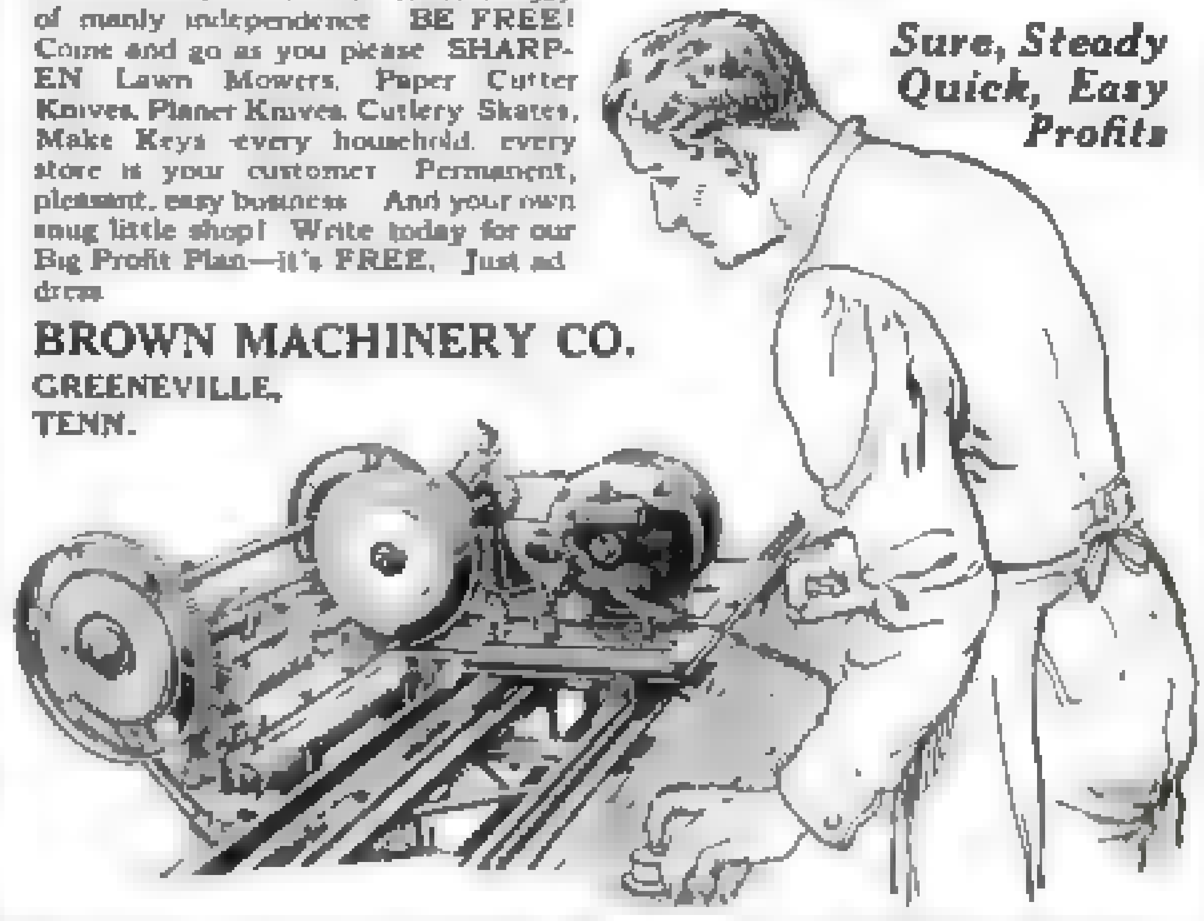


The use of a standard pipe plug greatly reduces the cost of making this type of machinist's lap

hole should be large enough to leave the wall only [illegible] or [illegible] in. thick.

Four saw cuts are run the length of the lap and the end is tapped to take a standard pipe plug, which will give enough expansion to permit lapping a hole .010 in. over size. The shank is turned either straight or tapered.

Clean machine grease or petrolatum rather than oil is mixed with the abrasive to be used with this lap.



Money Making Opportunities for Popular Science Readers

Readers of POPULAR SCIENCE MONTHLY will find scores of opportunities in this section pages 114 to 142 for making more money

Short Cuts to Success

(Continued from page 4)

I had no special qualifications, was merely an average man, but the knowledge I gained from the National Salesmen's Training Association has helped me into a good position, where I have earned over $200 in a single week, so is it any wonder that I am interested in this course and the opportunities it offers to other men? Yours truly,

F. E. [illegible]

The importance of specialized training is forcibly brought out in the letter below. From "common laborer," through an International Correspondence School course in ornamental designing to manager of a tapestry mill at $6,000 a year and financial independence for the rest of his life is the story W. H. Fletcher, of Hadley, Pa., tells in his letter —

(Continued on page 11[illegible])

$100 in CASH PRIZES

For the best letter of 150 words or less answering the question—

"What advertisement in the 'Money-Making Opportunities' Section interests you most—and why?"

we will pay on May 10th the following—

CASH PRIZES	
First Prize	$50.00
Second Prize	25.00
Third Prize	10.00
Fifteen Prizes of $1.00 Each	15.00

First read every advertisement in the Money-Making Opportunities Section on pages 114 to 142. Pick out the one that interests you most and then write a letter—*not exceeding 150 words*—telling us why you find the advertisement you have selected the most interesting.

Entries for the contest will close on April 1st. The prize winners and their letters will be published in the June issue of POPULAR SCIENCE MONTHLY.

Address your letter to
Contest Editor
MONEY-MAKING OPPORTUNITIES
POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York

Short Cuts to Success

Continued from page 114

Contest Editor:

In looking over the advertisements, I cannot help but look with pleasure at the advertisement of the I. C. S. of Scranton, Pa.

Because it was the enrollment in the I. C. S. that put me in the independent position I am in today after poor health overtook me.

I was working as a common laborer at a very small wage. I enrolled for a course of ornamental designing in the International Correspondence Schools. I got a position as designer in a tapestry mill and later as manager and designer at a salary of $6,000 a year.

And then ill health overtook me. I was advised by my doctor to quit the mills and rest. I was financially in a position to buy me and wife a nice place in the country where we live quiet and peacefully. We are financially independent.

The I. C. S. helped me, and I know it will help other young men if they will give it an opportunity.

W. H. Freeman

From a "trainee's job on a measly income" to an important position with the Westinghouse Electric Manufacturing Company is what a course in the Chicago Engineering Works brought Stephen Karbanish who says:—

Dear Sir:

Page 121, February issue, POPULAR SCIENCE MONTHLY contains the advertisement of the Chicago Engineering Works. here is an ad which represents a "Money Making Opportunity" of the FIRST CLASS.

Six years ago, I was a miner, untrained, and doing a miner's job on a measly income.

Lack of confidence and self reliance urged me to become a "Cooke trained" man. I am now not a miner but a trained employee of the Westinghouse Electric Manufacturing Company of Pittsburgh, N. J.

I was head maintenance man of the D. L. & W. Shops for two years, the position which I reluctantly gave up and became partly responsible for the origin of our Company's Plant some City, namely Scranton, Pa., the letter-head of which appears above.

Does not that represent the climate of but ONE opportunity? I am 25 years of age.

Yours for a greater Success,

Stephen A. Karbanish

Mrs. Wilbur Wilbur says may well vote the advertisement of Moler System of Colleges headed "Fascinating" as the most interesting to her. It, as she says in the letter below, reminded her of her first first-class hair cut—and the husband that resulted.

Contest Editor:

Once—not many months ago—I went into a barber shop. And upon that hangs the tale.

So when I ran across the advertisement of the Moler System of Colleges, with its "Fascinating" appeal, in the February number of POPULAR SCIENCE MONTHLY, I smiled and thought of the first first-class haircut that I ever got, and also of the husband

(Continued on page 116)

Short Cuts to Success

(Continued from page 115)

which resulted from the visit. And he is just as fascinating as the Moler System and These Colleges must be all right if they send out graduates like my husband

Yours truly,
(Mrs.) William Williams.

Decide now what you want to be in life. Read carefully *all* the advertisements on pages 114 to 142. Then fill in the coupons or write the advertisers you select as being most interesting. These advertisers are ready and willing to help you. The booklets and other information they will send you will be extremely interesting and of great importance to your future.

Complete List of PRIZE WINNERS In the February Contest

FIRST PRIZE $50
H. M. Dwinell, Hayward, Calif.
(Bureau of Inventive Science)

SECOND PRIZE $25
Frederick W. Lents, Weatherly, Pa.
(La Salle Extension University)

THIRD PRIZE $10
F. F. Cottrill, Fort William, Ont.

PRIZE WINNERS who receive $1.00 each for their letters

W. H. Fletcher, Hadley, Pa.
(International Correspondence Schools)

E. B. Christian, Thorndale, Texas
La Salle Extension University

C. M. Minott, Bangor, Maine
(Chicago Engineering Works)

Arnold H. Chow, Honolulu, Hawaii
(London School of Cartooning)

R. E. Hancock, Portsmouth, Va.
Theo. Audel & Co.

Elton G. Davies, Casper, Wyoming
American School of Chicago

Stephen A. Ferbanish, Scranton, Pa.
Chicago Engineering Works

B. F. Verner, Brevard, N. C.
Munn & Co.

J. Marvine Brown, Guinea Mills, Va.
La Salle Extension University)

L. S. Lewis, Asheboro, N. C.
Theo. Audel & Co.)

H. W. Coulter, Johnstown, Pa.
International Correspondence Schools

C. Nelson, Academy, S. C.
International Correspondence Schools

L. B. Pearson, Coalwood, W. Va.
McSweeney Auto, Tractor and Electrical Shops)

Clifford E. Fox, Erie, Pa.
International Correspondence Schools)

Mrs. W. Williams, Mt. Pleasant, Iowa
Moler System of Colleges)

MAKE BIG MONEY IN ELECTRICITY!

800% Pay Increase "I now make 8 times what I earned when I enrolled. I used to get $50 a month—now it's $400." Carroll Mosebler, Chaska, Minn.

$9,000 a Year Auto Electricity pays W E Pence, Albany. Ore., over $9,000 a year. 58 men enrolled for this training on his recommendation.

$1,000 a Month John Jirinec, 336 Dumars Ave., Astoria, L. I., now earning $12,000 a year, says, "Cooke Training is responsible for my big income."

$125 a Week "Depend on me as a booster," says A. Schreck, Phoenix, Ariz. "I make over $500 a month. Your advertisement started me to success."

$700 in 24 Days "Thanks to you I made $700 in 24 days in radio," says F G. McNabb, 7 W 16th St, Atlanta, Ga. "I recommend your training everywhere."

Thousands of Cooke Trained Men Earn $70 to $200 a Week!

Send the Coupon below for full particulars of my great pay-raising training—the training that has fitted thousands of men for jobs paying $3500 to $10,000 a year in Electricity

Be an ELECTRICAL EXPERT
Learn at HOME in your SPARE TIME!

Don't you keep on working for $25 or $35 a week. Get into Electricity. Thousands of Cooke Trained Men who knew nothing about it a short time ago are now earning $70 to $200 a week as Electrical Experts—and they don't work half as hard as you do. Why stick to your small pay job? Why stick to a line of work that offers no chance—no promotion—no big pay? Get into the world's greatest business. Electricity needs you. I'll show you how to do it. Get ready for the big-pay job now.

Electrical Experts are in Big Demand

Even ordinary electricians — the "screw driver" kind — are making big money, but trained men—Electrical Experts who get the top salaries—are needed more now than ever before. Thousands of Cooke Trained Men easily earn $3,500 to $10,000 a year. That's the kind of a job you want—where you can plan and boss—supervise the work of others or go into business for yourself. Get started towards one of these big-pay jobs now. Learn to earn $70 to $200 a week—you can do it with Cooke training—recommended by more than ten thousand successful graduates. Just mail the coupon below

Employment Service—No Extra Charge

I will train you for a big-pay job and then help you get it without extra charge. Hundreds of employers look to me for the electrical men they hire. Last year I placed over one thousand men at big raises in pay. Hundreds of others were promoted by their employers through the help of my Vocational Service and other hundreds went into business for themselves with the help of my special Business Training. Mail coupon for big free book which explains this service and fourteen other features, many of which can't be had anywhere else.

Age or Lack of Experience Bars No One

You don't need experience. You don't have to be a College man. You dont have to be even a high school graduate. As Chief Engineer of this big two million dollar institution which does a general Consulting Engineering Business besides operating one of the world's greatest Training Schools, I know just what training you need to make a big success in electricity. Let me give you that training with my simplified, complete home course—the world famous "Cooke" Training—built on my own 25 years of engineering experience with the help of nearly 50 other engineers. Learn to earn $70 to $200 a week — only spare time needed.

My Training Pays for Itself

You can start earning extra money a few weeks after you start my training. I give you special instruction for doing simple electrical jobs in your spare time—show you how to get these jobs and tell you what to charge. Many of my students make as much as $25 a week extra this way while studying. My course more than pays its own way

Your Satisfaction Guaranteed

I am so sure I can make you a big success in Electricity, just like I have done for the men whose pictures you see here and thousands of others who now boost my training, that I will guarantee your satisfaction with a signed, money-back guarantee bond. If my training doesn't satisfy you after you have finished, you get back every penny you pay me. A two million dollar institution stands back of this guarantee.

My Big New Electrical Book FREE!

The 1926 Edition of my big book "The Vital Facts About Electricity" is just off the press! Clip coupon NOW for your copy. It's FREE! ... actual pictures of Electricity at work ... dozens of success stories ... what you can do in the Big Pay Profession ... you'll find it all in my up-to-the-minute electrical book. Send for it today!

Get Started Now—Mail Coupon

Get my free book —"The Vital Facts About Electricity." Read about the success of hundreds of other men—men who recommend this training and whose names and addresses are given in my book. Get the real dope about your opportunities in Electricity. See how easy it is to get started on the road to jobs that pay $70 to $200 a week. Don't deny yourself this chance to make big money. Get the facts NOW. MAIL COUPON AT ONCE for the facts and my guarantee.

5 WONDERFUL WORKING OUTFITS GIVEN WITHOUT EXTRA CHARGE

1. **Laboratory and Experimental Outfit**— Complete material for interesting experiments.
2. **Bell and Alarm Outfit**— Electrical apparatus, material and tools — a complete installation Kit.
3. **Electric Lighting Outfit** — Switches, Wire, Lights, etc — everything needed to make up all complicated electric lighting circuits.
4. **Electric Power Outfit** — Famous "Cooke" Motor and other apparatus. Not a toy—but a real, honest to goodness workable machine.
5. **Transformer Outfit** —Complete parts for building and winding this widely used equipment.

The Cooke Trained man is the "Big Pay" Man

L. L. COOKE, Chief Engineer,
Chicago Engineering Works, Inc.
Dept. 34
2150 Lawrence Avenue
Chicago, Illinois

L. L. COOKE, Chief Engineer,
Chicago Engineering Works, Inc.
Dept 34
2150 Lawrence Avenue, Chicago, Illinois

Send me at once, without obligation, your big illustrated book and complete details of your Home Study Course in Electricity, including your outfit and employment service offers.

Name..

Address..

Occupation..

Quick Action Advertising

Rates 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the June, 1926 issue should be received by April 5th

ADDING MACHINES

ADVERTISING SERVICES

ART WORK AND MANUSCRIPTS

AUTOMOBILES AND ACCESSORIES

AVIATION

BOOKS AND PAMPHLETS

BUILDING MATERIALS

BUSINESS OPPORTUNITIES

BUSINESS SERVICES

CHALK TALKS

DISTRICT MANAGERS AND REPRESENTATIVES WANTED

DOGS

EDUCATION AND INSTRUCTION

FINANCIAL AND INVESTMENTS

FORMULAS

FOR BOYS

FOR INVENTORS

3 Drafting Lessons Actually FREE!

—to prove you can learn at home in spare time!

We have invented a new simplified way to teach Drafting—the first real improvement in Drafting home instruction in history. We want you to see it, try it—without one penny of cost or obligation. We want to show you how we get away from the copying methods used in the past. See how we make you *think*, solve problems, do actual drafting room jobs *from the first lesson*.

I *will make this contract with you—*

When you enroll for our home-training in Drafting, we agree to give you:

1. Complete Drafting training, by the new Practice-Method.
2. Professional Drafting Outfit, as illustrated.
3. **We will help you get a good Drafting position** at a substantial increase in pay.

AMERICAN SCHOOL
—the Million Dollar Educational Institution

Or we'll refund every cent of your money.

O. C. Miller

THE AMERICAN SCHOOL, a [illegible] dollar *No-Profit* Educational Institution now offers men a *double* service—training for a specific job, then finding the job. For one small price, on terms of only $5.00 a month, you are now assured of definite benefits, both in position and salary. Write for complete information—*today!*

Draftsmen Wanted! $60 to $125 a week!

70,000 [illegible] Get ready to [illegible] **500** men [illegible] Coupon brings complete information.

A new, rapid, simplified training

Copying drafting lessons [illegible] Job-Method [illegible] drafting room [illegible] American School [illegible] for a good job at big pay when they graduate.

[illegible]

men experienced in [illegible]

[illegible]

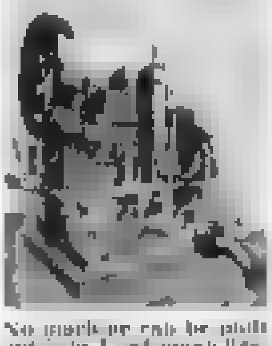
WIN SUCCESS thru DRAFTING

Drafting [illegible] work. Short hours. Big pay. And the [illegible] always [illegible] for promotion to [illegible] positions. [illegible] and all the [illegible] and Mathematics [illegible] experts require.

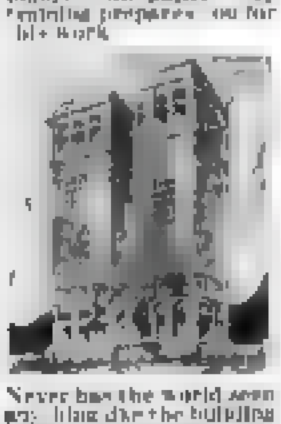
5 BIG-PAY Branches

The big money in Drafting goes to men who [illegible] Drafting or [illegible] **$60** to **$125** a week. [illegible]

FREE Job Service!



No machine can be [illegible] buildings and [illegible] training prepares you for [illegible] work.



Never has the world seen [illegible] building [illegible] demand for real draftsmen.

The American School now offers its students and graduates [illegible] service of an employment [illegible] with employers of [illegible] men all over [illegible] We have placed hundreds of men in good [illegible] We've made this training so complete, so practical, so easy to master, that our students are bound to make good. And, so because the demand for real Draftsmen [illegible] the supply [illegible] training actually prepares men for good Draft [illegible] positions we back it with a Free Employment Service.

Coupon Brings 3 Lessons FREE!

Get them. Test your own ability to learn Drafting and get ready for a fine job and big pay. Coupon also brings [illegible] complete information about your opportunities in Drafting. Mail it today.

Costly Drafting Outfit Given!

Fine imported instruments like these help you learn Drafting quickly and easily. These standard quality, full size instruments, board, table, triangles, T-square, ink, protractor, etc., given to every student without extra cost.

O. C. Miller, Director Extension Work — Dept. D-475

AMERICAN SCHOOL Drexel Ave., and 58th St., Chicago

3 Drafting Lessons Actually FREE!

O. C. MILLER, Director Extension Work,
AMERICAN SCHOOL,
Dept. D-475, Drexel Ave. & 58th St., Chicago

Rush 3 Free Drafting Lessons, Job Service Guarantee [illegible] time.

Name ....

Street No. ....

City .... State ....

FOR INVENTORS

PATENTS. [illegible] Free personal advice. [illegible] Washington, D. C.

[illegible]

FOR MAN AND WOMEN

[illegible]

FOR SALE

[illegible]

FOR THE HOME

HOT WATER ON TAP [illegible]. Write John Kirkeby [illegible]

MEN! Women! Make [illegible] Columbia Rugs, genuine fluff [illegible] [illegible]

[illegible] Popular Science Monthly [illegible] No. 48, Radio Receiver with three stages of ampli[illegible] Send 25c for each blueprint [illegible] Popular Science Monthly, 353 Fourth Avenue, New York, N. Y.

GAMES AND ENTERTAINMENTS

BOOK of Magic, Set Trick Cards, and Illustrated Catalog 10c. Piedmont Novelty Shop, Box 631, Danville, Va.

HELP WANTED

[illegible]

HELP WANTED INSTRUCTION

DETECTIVES Earn Big Money. [illegible]

[illegible]

MEN wanting forest ranger, railway mail clerk, and other government positions, write for free particulars of examinations. Mokane, Dept. B-30, Denver, Colo.

HOW TO ENTERTAIN

PLAYS, musical comedies and revues, minstrel [illegible] [illegible] T. S. Denison & Co., 623 So. Wabash, Dept. 58, Chicago.

INCORPORATIONS

DELAWARE Incorporations. Charters. Fees small, [illegible]. Chas. G. Guyer, 901 Orange St., Wilmington, Delaware.

INDIAN GOODS

INDIAN Goods [illegible] Company, 466 Connecticut, Buffalo [illegible]

INFORMATION

CORRECT complete information any scientific technical [illegible]

[illegible]

INSECTS WANTED

[illegible] Butterflies [illegible] Dealer in Insects, Dept. [illegible]

LABORATORY AND CHEMICAL SERVICES

[illegible]

LANGUAGES

[illegible] Chinese, French, Spanish [illegible] Languages [illegible] New York.

LETTER SPECIALISTS

[illegible]

LISTS

[illegible]

MACHINE TOOLS

[illegible] Machinery and Tools [illegible] Manufacturing Co. [illegible]

MAGIC TRICKS

[illegible]

MANUFACTURING

DEVELOPING ideas and manufacturing our specialty. Absolute satisfaction. 33 years experience. Write us. The M. & D. Die & Specialty Co., 2018 Elm St. [illegible]

MISCELLANEOUS

[illegible]

MODELS AND MODEL SUPPLIES

[illegible] and model supplies. Send for catalogue. The [illegible] Model Works, Tinley Park, Illinois.

[illegible]

MOTORCYCLES, BICYCLES, SUPPLIES

OVERSTOCKED. Used Motorcycles, 1932 Indian [illegible] Henderson Deluxe $120.00 [illegible]

[illegible]

MAIL ORDER BUSINESS

[illegible] Sample and plan 25c. [illegible]

MOTORS, ENGINES, MACHINERY

[illegible]

MOVING PICTURE FILMS

[illegible] Brighton, Mass.

MUSICAL

[illegible] Toronto, Canada.

OPTICAL GOODS

[illegible]

OFFICE DEVICES

[illegible]

OLD MONEY WANTED

[illegible]

PATENT ATTORNEYS

PATENTS. [illegible]

[illegible]

PATENTS, Trade Marks, Copyrights. [illegible]

PHOTOGRAPHY AND SUPPLIES

HAVE you a camera? Write for free sample of our big magazine [illegible]

[illegible] Studios, Dept. [illegible] Michigan Ave. [illegible]

[illegible]

THIRTY [illegible] Milwaukee, Wis.

PRINTING AND ENGRAVING

[illegible] 200 ... Bond Letterheads ... and 250 envelopes, money with order. Job Printing Specialty. National Printing Company, Dept. [illegible]

[illegible] ... Letterheads $3 ... envelopes, one thousand ... The Courier Company, Zanesville, Ohio.

[illegible] Printing for Less Money. Write us about your printing needs ... [illegible] Worcester, Mass.

[illegible] ... Burning, Mass.

PRINTING OUTFITS AND SUPPLIES

PRINT ... [illegible] ... Write for catalogue presses ... paper, etc. Press Company, [illegible]

RADIO

RADIO FANS ... [illegible] ... New York.

SALESMEN AND AGENTS WANTED

[illegible] ... Write for free samples ... Madison ... New York.

[illegible] ... New York.

[illegible] ... Co., [illegible]

[illegible] ... Popular Science Monthly ... New York.

[illegible] ... Dept. [illegible]

[illegible] ... Co., [illegible]

AGENTS ... gold letters for store windows easily applied ... Metallic Letter Co., [illegible] Chicago.

[illegible] ... Accessories ... [illegible]

[illegible] ... Popular Science Monthly ... New York.

[illegible] ... Chicago.

[illegible] ... Distributors, Dept. [illegible]

AGENTS ... [illegible] ... Freeport Mfg. Co., [illegible]

[illegible] ... Decatur, Illinois.

[illegible] ... Joplin, Mo.

[illegible] ... [illegible]

AGENTS ... New Selling Plan ... Chicago, Ill.

[illegible] ... [illegible]

[illegible] ... checkerboards, signs ... [illegible]

[illegible] ... automobile parts ... Philadelphia.

AGENTS ... Rubber Repair for tires ... Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

WE pay $48 a week ... [illegible] ... Company, Dept. A48, Chippewa Falls, Wisc.

Get Ready— QUICK! For a Big-pay JOB in ELECTRICITY

I can help place hundreds of men in fine Electrical jobs at salaries from $60 to $125 a week. They need not be high school graduates (the grades will do) but they must be willing to devote part of their spare time to learning Electrical principles and practice by a new Job-Method built by 23 leading Electrical Engineers, and simplified for home-study. 3 Lessons sent you absolutely Free to prove how interesting and easy and valuable this instruction has been made.

Your name here *Wm. C. Campbell*

When you enroll for my home-training in ELECTRICITY I agree to give you:

1. Complete training, including Electrical Engineering, Ignition, Radio, etc.
2. Four outfits of standard tools and materials, including a $10 motor.
3. I WILL HELP YOU GET A GOOD JOB AND A RAISE IN PAY or I will refund every cent of your money.

AMERICAN SCHOOL
by *Chief Engineer Dunlap*

AMERICAN SCHOOL — the Million Dollar Educational Institution

Training Built by 23 NOTED Engineers

This is not a one man ... [illegible] ... complete and up to date.

General Electric Co.
Commonwealth Edison Co.
Crocker Wheeler Co.
Cutler Hammer Mfg. Co.
American Tel. & Tel. Co.
Westinghouse Elec. Co.
Western Electric Co.
Underwriters Labs. Inc.
Dartmouth College
Columbia University
Massachusetts Institute of Technology
Lehigh University
University of Vermont
AND MANY OTHERS

PROOF! that we place men in Jobs

"I received your letter today and [illegible] ... that I got the position."
JOHN ALMQUIST III.

Louisiana Public Service Co.
New Iberia, La.

"Under ... [illegible] ... his character and ... [illegible]"
J. G. DIX, President.

"I have just received a notification from ... Employment Department to start to work ... I am very grateful to you for this help you gave me."
JEROME OVERHOLT.

I will make this contract with you:

A MILLION DOLLAR INSTITUTION stands back of this agreement to PREPARE you to fill a well-paid Electrical job and then to help you FIND THE JOB—or to refund the small amount charged for your training! Here is your opportunity to get out of the class of under-paid, money-worried men, always out of a job or afraid of losing one. To step into the rank of men who are paid *Big Salaries* for what they KNOW, instead of receiving starvation wages for what they DO! Get details of this wonderful opportunity *today!*

4 Costly Electrical Outfits Given!

I send you absolutely without extra cost, as a part of this training, 4 costly outfits of standard size tools and materials, so you learn Electricity BY DOING actual Electrical jobs. One of these outfits is a $10 Electric Motor—a real motor and generator, the same type as the big fellows in a power plant. I send it to you "knockdown" and have you wind the field and armature and assemble it. *Thats the way I teach every branch of Electricity!* House-wiring outfit, etc., included.

Get My Job Service Guarantee Offer Quick

If you have reached the point where you realize YOU MUST train and specialize to get anywhere, *write me immediately!* I will show you the wonderful opportunities, the enormous salaries, the many openings waiting in this billion dollar industry. I will tell you how I offer a new combination *Training-and-Job Service*, which is practically a guarantee of your success. Mail coupon and get 3 Free Electrical Lessons and complete information.

Chief Engineer Dunlap, Electrical Division
AMERICAN SCHOOL Drexel Ave. & 58th St. Dept. E-475 — Chicago

3 Electrical Lessons Free!

Chief Engineer Dunlap, Electrical Division
AMERICAN SCHOOL
Dept. E-475, Drexel Ave. & 58th St., Chicago

Send me your combination TRAINING AND JOB offer, 3 Free Electrical Lessons, facts about the opportunities in Electricity, etc.

Name ____
St. No. ____
City ____ State ____

SALESMEN AND AGENTS WANTED

[illegible]

SALESMEN AND AGENTS WANTED

[illegible] averages $2.50 [illegible] commissions. Possibilities $500 [illegible]

[illegible]

EARN $10 daily silvering mirrors, plating and re- [illegible]

[illegible]

SALESMEN AND AGENTS WANTED

[illegible]

Pocket Cigar Lighter [illegible] What makes [illegible]

[illegible]

TYPEWRITERS AND SUPPLIES

[illegible]

TYPEWRITERS. All Make [illegible] Lowest prices. Send for price [illegible] where. We save you money. [illegible] Long Branch, N. J.

[illegible] GERMANY

[illegible]

WANTED

[illegible] N. Y.

What Burbank Plans to Do

Continued from page 12

"Marriage of the physically, mentally and morally unfit should be prohibited, and that prohibition made absolute. Crossing a poisonous plant with a non-poisonous one and so producing an unwholesome growth which is a menace to the whole garden is wrong; but how much worse it is to cross two poisonous plants, and then set their poisonous descendants loose over the earth! So with human beings."

Greater than all his plant discoveries, greater than his achievement of adding grains worth millions of dollars to our annual production, greater than the wonders he has wrought in providing new fruits for man, Burbank considers the development of his idea that children, like plants, can be improved, trained and developed. His greatest hope in life is to see this idea applied to the coming generation in America, and in the whole world.

"For half a century," he said, as he bade me good-by, "I have been guiding a vast army of millions of plants—grains, vegetables, fruits and flowers—toward the goal of improvement, so that they might be of greater value to man. In those fifty years there has been growing steadily in my mind the belief—yes, the knowledge!—that in the development of the plant lies a great object lesson for human beings. This fact I consider my most valuable discovery. I have proved it many times, and I may state it in two sentences, the second the corollary of the first:

"First, that plants are pliable and amenable to the wishes of man, and that they may be bred and trained and developed just as animals may be bred and trained and improved.

"Second, that the human plant, the child, may be trained, developed and improved just as, under the hand of a skilled gardener or a trained botanist, the best that is in each plant may be brought out."

What Our Readers Say

I use your magazine in my classes in science, and find it a great help.—H. P., Washington, D. C.

What appeals to me most in Popular Science Monthly is that it contains everything a person wants to read from a scientific and technical standpoint.—F. S. H., Terre Haute, Ind.

The best educational magazine on earth.—G. C. W., Caddo, Okla.

My reading nowadays covers no less than ten magazines, weekly and monthly, but Popular Science Monthly yields me more substantial and satisfactory information than any three or four of the others combined.—J. G. W., Philadelphia, Pa.

Popular Science Monthly is the cheapest and best text-book that any English class can have as soon as they read English somewhat intelligently.—M. A. G., Monterey, N. L., Mexico.

He Pawned His Umbrella to Give Us Rubber

(Continued from page 18)

His "acid-gas" process, as he called the aqua fortis treatment, was still worth something. With it, he began making more overshoes, and under it he sold licenses to other manufacturers. But there was little more than a living in it, just sufficient to keep the Goodyears alive long enough for another stroke of good luck.

Charles drifted to New Haven in 1837. There he met an old friend, Nataniel Hayward. This Hayward said he had had a dream in which he had been told to mix sulphur with gum and set it out in the sun. When he awoke, he tried the plan and apparently succeeded. Nobody could explain exactly what the sun did, but certainly the curing seemed satisfactory. Out of the little he could scrape together, Goodyear bought Hayward's patent. On rubber sheets made in this way, he printed newspapers and made small articles. As long as the sheets were thin, all went well.

BUT for thick rubber—well, Goodyear got his next lesson from a set of mailbags, ordered by the United States Post Office. They were beautiful things to look at, and he was proud of them when he hung them up in his shop. Colored with chrome, white lead, and vermilion, they looked almost like leather. But, when he got back from a short vacation, his bags had all melted and fallen to the floor. Everything heavy that he had made and sold—life-preservers, cushions, and so on—came back from his disgusted customers. Once more he went broke.

His old father and mother were dependent upon him, and he had to cut them down to almost nothing. His wife went back to spinning, and his children could not stay in school. All his friends urged him to go back to hardware and make a decent living. But his own faith was as strong as ever. "It must be done, and it will be done," he insisted. He took courage for fresh vision and plunged into other experiments.

AND then, one night, standing in the kitchen with a group of his friends, he was boring them with his everlasting talk of rubber, even gesticulating with a piece of it in his hand. He *happened* to hit the stove, and the stove *happened*, that night, to be hot. The piece he held was not melted, but charred. He stood staring down at it. To none of his friends did this mean anything, but to him it was turning the corner in a long, hard road.

If the charring process could be stopped at the right point, that stickiness which had always been the biggest difficulty might disappear from the center, as well as from the outer surface.

"I tried high temperatures," he recalled in later years. "When I plunged india-rubber into melted sulphur, at great heats, it always charred, but never melted. Even before an open fire, I got the same result. And along the edge of the charring there would *(Continued on page 125)*

He Pawned His Umbrella to Give Us Rubber

(Continued from page 124)

be a border that was not charred, but perfectly cured."

Again he stayed up night after night, bending over his wife's stove. Some of the rubber he made into a cap for himself, to prove that it was tough and durable. In fact, this making rubber clothes for himself and his family long had been a habit with him. So much so, that it was said of him, to strangers who inquired: "If you see a man in a rubber coat, vest, stock, cap, and shoes, carrying a rubber purse—without one cent in it—that's Goodyear!"

IT IS a curious fact that Goodyear worked almost entirely alone. He was the only man in America who believed wholly in Goodyear. More than once, of course, his friends did save him and his family, by a few dollars, or a little coal, or a barrel of flour. But this was charity—for they still thought him a fool.

At last he was able to work in a plant where there were ovens that could be brought slowly up to a high heat and held there. And so, in 1841, he succeeded.

Gum, white lead, and sulphur, mixed and fused at heats around 270 degrees, gave him a product that was indifferent to heat or cold, always elastic and unbelievably strong. He called the material "metallic gum-elastic," but very soon it became known as "vulcanized rubber" after the mythological Vulcan tending over his furnaces. The scientific victory was won and out of this substance Goodyear's daughter made the first pair of real rubber shoes in history.

Yet, even then, the world doubted. Only Goodyear foresaw the long list of materials in industry that would be affected. No one else appreciated that rubber now could replace, under certain conditions, such things as iron, steel, copper, slate, stone, wood, leather, cotton cloth, wool, silk, paper, crockery, pottery, and a score of other things.

IT IS odd that Goodyear should not have thought of tires. As a matter of history, it was Robert Thompson, an Englishman, who invented pneumatic tires in 1845, but it was nearly fifty years before they came into really practical use. But, of course, modern methods of treating rubber for tires all reach back to Goodyear and his discovery.

He had many other ideas—lifeboats, bolsters, pillows, and all sorts of medical instruments. He even planned to make the furniture aboard ship of rubber, so that each piece could be blown up for a life-preserver in emergency.

Much has been learned about rubber and about the vulcanizing process since Goodyear's day. But it is worth remembering what Daniel Webster said, in his argument to win a great case for Goodyear in the United States courts:

"A new material has been introduced into the arts, nothing less than elastic metal. I say that there is not in the world a human being who can stand up and say that it is his invention, except the man sitting there—Charles Goodyear."

Taking Chances Is Movie News Man's Job

(Continued from page 44)

he is also still a comparatively young man.

Carl was one of a group assigned to shoot a tank test at Aberdeen, Md. One man was inside a leading tank; another was on top of a sister tank. Carl, exercising veteran's preference, escaped the tank-riding job—nasty because of the exhaust gases—by taking ground work. That is, Carl set up his camera close by the charted course of the tanks, in a wood where the big machines were scheduled to knock down a path, crunching underfoot whatever trees they might encounter.

THE tank formation, ponderous, noisy as a hundred hard-driven locomotives, plunged into the wood. Trees fell to right and left. Carl was getting his share of a magnificent picture. About 100 yards in front of Carl stood an oak—a splendid young tree, more than fifteen inches through at its base. A tank hit it head-on—a terrific shock of tons of metal. From the top of the tree a shower of branches catapulted back over the path of the tank.

Later, the tanks assembled at the starting point. The cameramen jumped from their tops and clambered out from inside.

Where's Carl?

None knew. On the run, his fellow cameramen followed the course of the tanks. They found Carl, crumpled beneath a tree limb, all but out. The one chance in a thousand had got him. From the oak had come a hurtling mass of leaves and limbs, and out of that mass, one limb had picked Carl as its target.

You may have seen that particular picture; it stopped suddenly as the oak bent beneath the tank's assault. The picture stopped because Carl couldn't grind any more. It cost Carl two months in the hospital.

That stunt was one of the myriad covered by news reels because they furnish spectacular pictures. The most sought after pictures, however, are not those that can be covered by all news reels; each organization trains its men to think up stunts that can be "pulled," as the slang of the game has it. When a man thinks up a stunt, and puts it over, it is called a brainstorm.

ON a dull afternoon, not more than a few months ago, a California cameraman sat in the office relieving the boredom of a dead spell in happenings by reading *Don Quixote*. His mind strayed from the printed page—stabbed at windmills. Windmills ... windmills!!! By jumping Jupiter, there was a picture! Take a ride on a windmill!

By night, he had located the windmill. By noon next day, his arrangements were made. Before sundown, he had his picture.

It was one of those "easy jobs." The cameraman merely had himself strapped securely to one of the huge vanes, gave the word to let 'er go, and ground out his film. Millions who attended motion picture theatres during the following few weeks enjoyed

(Continued on page 138)

PATENTS

INVENTORS Write for these FREE BOOKS!

At the left is a view of my drafting and spe[illegible] offices where a [illegible] staff of experienced [illegible] in my constant [illegible]. All [illegible] specifications are prepared under my personal supervision.

PROTECT YOUR IDEAS

Take the First Step Today—ACTION COUNTS

If you have a useful, practical, novel idea for any new article or for an improvement on an old one, you should communicate with a competent Registered Patent Attorney AT ONCE. Every year thousands of applications for patents are filed in the U. S. Patent Office. Frequently two or more applications are made for the same or substantially the same idea (even though the inventors may live in different sections of the country and be entirely unknown to one another). In such a case, the burden of proof rests upon the last application filed. Delays of even a few days in filing the application sometimes mean the loss of a patent. So lose no time. Get in touch with me at once by mailing the coupon below.

No Charge for Information on How to Proceed

The booklet shown here contains valuable information relating to patent procedure that every inventor should have. And with it I will also send you my "Record of Invention" form on which you can sketch your idea and establish its date before a witness. Such evidence may later prove valuable to you. Simply mail the coupon and I will send you the booklet and the "Record of Invention" form together with detailed information on how to proceed and the costs involved. Do this NOW. No need to lose a minute's time. The coupon will bring you complete information entirely without charge or obligation.

Prompt—Careful Efficient Service

This large, experienced organization devotes its entire time and attention to patent and trademark cases. Our offices are directly across the street from the U. S. Patent Office. We understand the technicalities of patent law. We know the rules and requirements of the Patent Office. We can proceed in the quickest, safest and best ways in preparing an application for a patent covering your idea. Our success has been built on the strength of careful, efficient, satisfactory service to inventors and trademark owners located in every state in the Union.

Clarence A. O'Brien

Registered Patent Attorney

Member of Bar of: Supreme Court of the United States; Court of Appeals, District of Columbia; Supreme Court, District of Columbia; United States Court of Claims

Practice confined exclusively to Patents, Trademarks, and Copyrights

Strict Secrecy Preserved—Write Me in Confidence

All communications, sketches, drawings, etc., are held in strictest confidence in strong, steel, fireproof files, which are accessible only to authorized members of my staff. Feel free to write me fully and frankly. Your case will have my personal attention. It is probable that I can help you. Highest references. But FIRST—clip the coupon and get my free book. Do THAT right now.

Mail this Coupon NOW!

CLARENCE A. O'BRIEN
Registered Patent Attorney,
6806 Security Savings & Commercial Bank Bldg., Washington, D. C.

Please send me your free book, "How to Obtain a Patent," and your "Record of Invention" form without any cost or obligation on my part.

Name

Address

(*Important: Print or Write name clearly*)

Taking Chances Is Movie News Man's Job

(Continued from page [illegible])

an old and unprecedented visual thrill. The cameraman who "pulled the brainstorm" had his thrill, too. With the prize money awarded him for the stunt, he bought a new aerial and B-battery for his radio, and earned the kick of his life by bringing in Havana. It's all in the way you define "thrill."

Checking a negative of submarine diving, run for him on the screen, a news reel editor not so long ago had an inspiration.

"Suffering cats!" exclaimed this go-getter (in words, at least, to that general effect). "Here we've had the boys shooting diving shots from an accompanying ship. Let's put 'em on the bridge of the diving sub, and have the sub come up just before she ought to go under. Ought to be a kick in that."

THE bridge of a submarine is atop its conning tower, the highest point on a submarine, and therefore the last to go under. On the appointed day, two news cameramen found themselves rolling along atop a submarine, all hatches battened down, steel trap door leading below through the conning tower closed—for all the world like riding a plunging steel cigar. No sign of life could come up to them from below; the whitecaps about them showed no living thing. Their cameras were pointed ahead, taking the knife-edge bow of the sub creaming through the waves.

Arrangements were that the sub would slowly submerge until the [illegible] of the conning tower would be the only solid part of her above water. She would then stop the dive, and rise.

Sink she did. The bow disappeared, visible now only as a gray shadow sliding beneath the waves. Lower she went. The men ground on, their lenses seven feet, six feet, five feet above the waves that sprayed against the conning tower sub-water. Four feet, three feet.

Then the always-to-be-expected unexpected! The sea was almost calm—whitecaps, playful little fellows, excepting one. The cameramen saw him coming; they longed to duck—but stuck where? A big fellow, a mere [illegible] of a seventh wave. He was a noble wave, foaming at his majestic crest.

BELOW, the keen eyes of the lieutenant in command, peering into the cross-haired sight of the periscope, saw the overgrown wave coming. He pressed a button. Compressor tanks hissed; the sub rose—but not before the wave had passed over. In a few seconds it was safe to open the conning tower hatch. The lieutenant scrambled up.

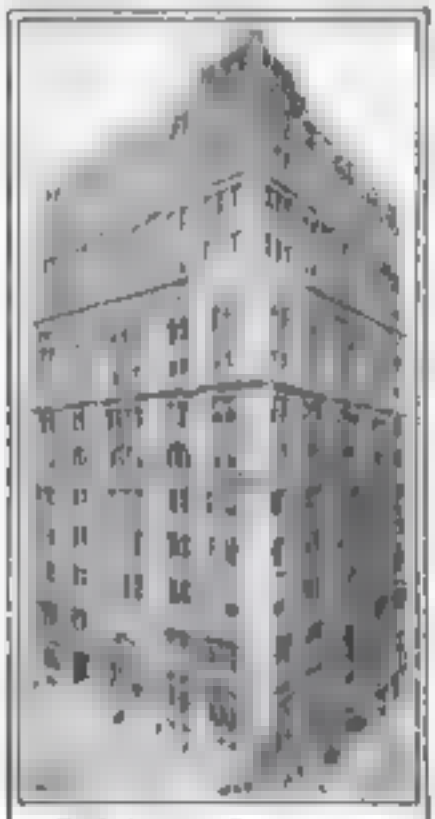
"Look out there, Cap'!" yelled one of the two cameramen, both of them wetter than the proverbial hen. "Don't knock against our tripod legs! We're getting her coming out of it."

Both of them having been bouncing around a moment before in the swirl of green water that marked the passing of the "big boy" wave, were now grinding away, hoping against hope that their film wasn't wet.

(Continued on page 130)

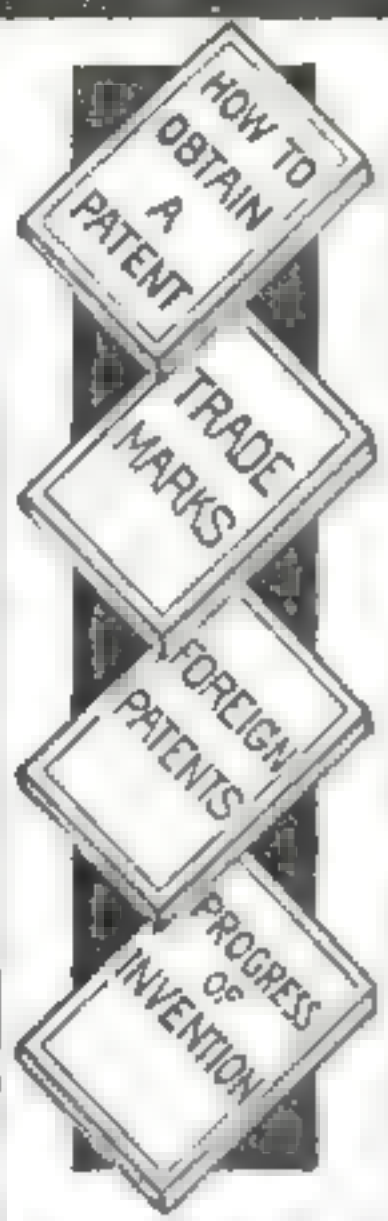
PATENTS TRADE-MARKS AND COPYRIGHTS

New York Office
Suite 1007 Woolworth Bldg.



Philadelphia, Pa., Office
Suite 615-619 Liberty Bldg

Washington, D. C., Office
Victor Bldg



OUR OFFER:

Your first step

Before disclosing an invention the inventor should write for our blank form "RECORD OF INVENTION." This should be signed, witnessed and returned to us together with model or sketch and description of the invention for INSPECTION and INSTRUCTIONS.

NO CHARGE FOR THE ABOVE INFORMATION

Our Four Books Mailed Free to Inventors

Our Illustrated Guide Book

HOW TO OBTAIN A PATENT

Contains full instructions regarding U. S. Patents. Our Methods, Terms, and 100 Mechanical Movements illustrated and described.

OUR TRADE-MARK BOOK

Shows value and necessity of Trade-Mark Protection. Information regarding *Trade-Marks and unfair competition in trade*

OUR FOREIGN BOOK

We have Direct Agencies in Foreign Countries, and secure Foreign Patents in shortest time and at lowest cost.

Progress of Invention

Description of World's Most Pressing Problems by Leading Scientists and Inventors

**ALL COMMUNICATIONS AND DATA STRICTLY CONFIDENTIAL
INTERFERENCE AND INFRINGEMENT SUITS PROSECUTED**

IMPORTANT

TO MAKE YOUR CASE SPECIAL AND AVOID DELAY YOU SHOULD HAVE YOUR CASE MADE SPECIAL IN OUR OFFICE to secure protection, save correspondence and obtain early filing date in Patent Office. To secure special preparation of your case send $25.00 on account with model or sketch and description of your invention.

Private Office, Victor J. Evans, with view of Patent Office Through Window

Highest References Prompt Attention Reasonable Terms

VICTOR J. EVANS & CO., Patent Attorneys

Main Offices: 760-9th St., N. W., Washington, D. C.

FREE COUPON

Gentlemen: Please send me FREE OF CHARGE your book [illegible]

Name

Address

Chicago Ill. Office
Suite 414 Tacoma Bldg

Pittsburgh Pa. Office
Suite 814 Empire Bldg

San Francisco, Cal., Office
Suite 1010 Hobart Bldg

Taking Chances Is Movie News Man's Job

(Continued from page 135)

But the film was wet, as both men found to their chagrin in a few moments. They asked the lieutenant to repeat the dive, which he did, and while the picture they obtained takes rank as one of the classics of news reel achievements, they both swear to this day (like fishermen telling of the big one that got away) that the picture the giant wave spoiled was the wow of all wows.

FOREIGN-POST cameramen and New York staff men on foreign assignment run the same gamut of everyday risk as the men in the United States. A news reel job is the same no matter in what language you name it.

Take the experience of one cameraman in Sofia during the exciting week that saw the Russian cathedral bombed with great loss of life. Existence became a ticklish touch-and-go thing those days in Bulgaria, the police were positively on hair springs. "No pictures!" was the edict.

A New York news reel cameraman had all but finished his job of "shooting" the great cathedral, the rescue workers, the shifting, nervous crowds. Two soldiers stopped him with sharp commands. They had two revolvers apiece and they plainly meant business.

The cameraman wasn't worried about himself. He knew that at most he might have to spend a night behind bars before his papers would clear him. But he had only a few minutes to make a train with his film. He thought fast, assuming an air of tremendous dignity he shortly pulled forth his United States passport. The officers showed a little more respect but also a little more uncertainty that he moved on with them.

"Your attention, Messieurs," the cameraman requested, adding another 100 percent to his dignity. He drew forth from an innermost pocket a small wallet he motioned to the officers to drive back the curious crowd about them. When this had been done, he cautiously showed the officers the wallet—and a small, green piece of paper therein. On it was printed a shield, with certain words in English clearly recognizable by any American.

THE officers snapped to salute: escorted him while he made the returning needed "shots"; helped him buy ticket without red tape and—marvel of marvels!—actually refused the generous tip he offered.

The little green slip was a cigar coupon—a stray that somehow had found its way into the wallet which enclosed pictures of the cameraman's wife and baby!

The next time you see a news reel, look beyond the screen. If you see a parachute jumper leap from a plane, picture the man behind the camera—he was right there, too! If you get dizzy looking down, down, down from the heights of some great steel structure, remember the man who climbed up there, with a sixty-pound camera on his back!

For, whatever the picture, the news reel cameraman has *got* to be *there!*

And he is.

What Could You Do with $50—?

See the Cash Prize Offer on Page 4.

The Fastest Thing on Legs

(Continued from page 27)

become largely an amusement of the very wealthy, it originated among the poorly paid miners and cotton mill workers of the north of England, and was brought to America by workers in the textile mills of New England.

For a thousand years or so, the greyhound was the favorite dog of the English aristocracy and coursing one of the popular amusements of the wealthy. The English working-man is as much a sport lover and as much a dog lover as is his more fortunate countryman, but the big greyhound was "too much dog" for the miner who often had to keep himself, his family and his dog in a single room. So the little whippet, which weighs anywhere from five to twenty-five pounds, the favored weights being from seventeen to twenty pounds, was obtained by crossing the Italian greyhound (the same dog as the English greyhound, but smaller) with the wire-coated fox terrier. Careful breeding has resulted in a dog that has the speed of the greyhound combined with the alert aggressiveness of the terrier.

WHETHER the racing whippet is brought up in a millionaire sportsman's kennels or in a working-man's home, its training starts when it is a small puppy. First, it is encouraged to take hold of and drag on a soft rag. After a few weeks of this, the "runner-up" goes a little way off and waves a handkerchief to excite the puppy, while another person holds it in leash, then slips the leash and lets the racer-to-be make a dash for the handkerchief. A cap pistol is used to accustom the dog to the sound of the starter's pistol.

After a few months of this preliminary training, the youngster is taken to a track and allowed to run against an older dog, the beginner being given sufficient handicap to make it certain that he will start his racing career with a victory. All through the early training, care is taken to keep his spirit from being broken by defeat. After every training race, the towel or handkerchief for which the dog has run is given to him as a reward, to chew and worry to his heart's content.

GOOD whippet trainers take the greatest pains to make sure that their charges get proper food, proper exercise, and proper grooming. Beef is the basis of the racing dog's diet—beef well boiled or well roasted. Vegetables, such as onions and parsnips, are given once a week by some trainers, and when a dog is lacking in "pep," a new-laid egg is beaten in with his other food.

Whippet races usually are handicap affairs, the dogs being handicapped according to weights and past performances. The dog on scratch always wears a red collar, and, in the order of their handicaps, the other dogs have white, blue, yellow, green and black collars. It is unusual for more than five dogs to be started in a single heat.

As the dogs are held on their marks by their "slippers," their runners-up go down the track (Continued on page 132)

The Fastest Thing on Legs

(Continued from page 131)

waving towels or cloths and calling and whistling to the dogs, finally taking up positions ten yards behind the finish line, so as to make sure that the dogs will run the full course at top-speed.

The "slipper" plays an important part in whippet racing. As the dogs, being thrown into their strides, go off to a flying start, and travel more than sixteen yards a second, the slightest slowness on the part of the slipper is fatal. So is the sort of nervousness that leads to a false start, for that is an offense punished by disqualification.

THE starter stands behind the slippers, where he is out of their sight, but many of the men and women who follow the game seem to have developed the knack of knowing when the "gun" is going off, and of always getting their dogs into action on the instant of the report. The most famous of all the slippers is Mrs. Chris Shuttleworth, of Santa Anita, Calif. Mrs. Shuttleworth's starting intuition is so well developed that she holds a distinct advantage over all the other slippers in the West. Slow-motion and ordinary motion pictures taken at the starting line have proved that her slips were synchronous with the smoke puff of the starter's pistol. She cannot explain just how she knows when the pistol is going off—but she knows.

It is possible that this human element will be taken from whippet racing by a mechanical starting box invented by F. S. Jack Davies, of Westfield, N. J., an experienced whippet trainer and racer. These boxes or traps are placed on the various handicap marks, the dogs watching their runners-up through apertures until the starter pulls the strings, or, in an electrified model of the device, throws the switch that opens all the doors simultaneously.

The judge at the finish line has a difficult task when three or four dogs cross the line well bunched. All he has to go by is the color of their collars. When his decision is made, the judge waves a flag of the winning color; or, on more elaborately equipped fields, an electrically controlled device gives the result of the heat to the spectators.

WHILE just now whippet racing in America is almost exclusively a sport of the wealthy, there is no reason why it should remain so. It is a game that should make strong appeal to any man who likes to train and handle animals—to the kind of man who would like to own a racing stable if he could only afford it. Breeding whippets may be combined with racing them. Fast whippets bring good prices.

Though whippets are bred almost exclusively for racing, they make good track and performing dogs, and also affectionate pets and companions. But it is as a racing dog that the whippet is most interesting—a miniature racing machine as perfect in its way as the thoroughbred racehorse; a racing machine that weighs only twenty pounds—but it's twenty pounds of running.

$100 in Prizes

See Cash Prize Offer on Page 4 in front advertising section

Tests to Make before You Buy Your House

(Continued from page 30)

handsomely enameled." I responded. "We can't expect oak in a moderately priced house. Soft wood is all right, especially if it is white pine, cedar, cypress, or redwood. Poplar or whitewood, birch, gumwood, and also southern pine are considerably used for trim. Quarter-sawed material—which costs more—is preferable, especially with the splintery and warpable kinds of wood. This method of sawing lumber tends to avoid splinters and prevent warping. It also lessens shrinking and swelling."

"What about the top flooring in this house?"

I NOTICED the kitchen and the bathroom had ordinary yellow pine, sawed flat grain. Probably the speculator figured that these floors would be covered with linoleum, so it didn't matter what they were. He did better by the living-room, using the same material but quarter-sawed stock. You see there is a remarkable difference. The flat grain surface has a blotchy design—shiny spots, streaks, and whorls. Nothing like this shows in the living-room. Here the grain runs in close parallel lines lengthwise of each board.

"This floor will stand more wear and will wear down uniformly besides staying where it belongs and yielding no crop of splinters. Incidentally, the quarter-sawed material is variously known in different parts of the country as rift sawn, comb grain, and edge grain."

"I have heard you speak of 'clear stuff.' What does that mean?" inquired Margery.

"It means lumber without knots. We saw quite a few knots in the subfloor where it doesn't matter; same with sheathing. But knots are bad in trim or in house siding or other exposed parts of a building. When the painter shellacs the knots and covers them with two or three coats of paint, the job looks perfect for quite a while. But in a few years, if not sooner, the resinous knots betray themselves in yellowish blotches."

WE EXAMINED the windows as far as possible, running the sashes up and down to see whether they worked freely and were properly counterweighted. I hesitated to mar enamel and maybe mangle woodwork by prying things open.

So we took it on faith that the conscientious speculator had framed the windows on all sides with double instead of single two-by-fours, had put a frame stiffening block midways of each long vertical side between inner and outer frames, had used blind casings well sealed with building paper, and had caulked with oakum the space under the sill.

"Look!" Tom stood in the dining-room, pointing dramatically at the unpapered, plastered space above a double-width doorway that led to the living-room. "See that crack in the middle. And you told me this house was framed in up-to-date style. (Continued on page 135)

Tests to Make before You Buy Your House

Continued from page 133

so it wouldn't settle unevenly and crack the plaster.

"That crack," I replied, "was not caused by house settlement. You don't see any others like that, do you? Consider that the break is above an extra wide opening. That means the space was not framed with enough rigidity. Probably there is a single two-by-four header below and a single two-by-four plate above, with a row of right-angle struts between. The header should be doubled and put on edge, the plate doubled, and diagonal braces put between the struts so as to constitute an unyielding truss."

I COMPLIMENTED the speculator on his stairway as we ascended to the second floor. It did not creak nor did the steps sag, from which I inferred there were three instead of two sawtoothed supports and that an extra or "rough" tread lay beneath the finished tread. There was a general let-down in quality and workmanship upstairs, but nothing was seriously amiss, and there was no use in carping at the low seven-foot ceiling.

Up in the attic we saw that the roof had a proper ridge, two by eight, to which the two-by-six rafters were well fitted and spiked at two-foot intervals. I would have liked rafters the same size as the ridge, and suggested to Tom that he might some time reinforce the present members with boards or lumber scrap nailed to their sides and fastened to the joists below. This would truss the roof frame against extra wind or snow loads, and tie it better to the house structure.

There was no firestopping between rafters where they met the house wall. But it wouldn't be difficult to nail boards all around against the rafter ends and fill the spaces with mineral wool or some other incombustible substance. This would be a cold seal as well as a fire seal. We saw that the roof sheathing was all right, of dressed and matched boards, over which some kind of asphalt shingles had been laid.

TOM and I found a ladder and scouted the roof briefly. We verified the fact that the flue lining went all the way down the chimney and that there were separate flues for furnace and fireplace. There was a good concrete cap on the chimney which extended well above the highest point of the roof. The flashings around the chimney and in a roof valley were tin. Why hadn't the builder used zinc or copper sheets instead and added a few dollars to his price? It could not be helped now; the tin would have to be kept painted. It was a lesser defect that gutters and leaders were of perishable material. They could be replaced any time with zinc or copper.

At the foot of the ladder, Margery chirped:

"Oh, please say we can buy this house!"

"You can with my blessing," I replied. "On the whole it is a good house, and long may you be happy in it."

She clapped her hands and invited me straightway to the housewarming.

Solutions to Mental Tests on Pages 31 and 32

Code Test

The average adult can write the words in six minutes and with no more than three errors. Omission of a dot counts as half an error. "Come quickly" is coded as follows:

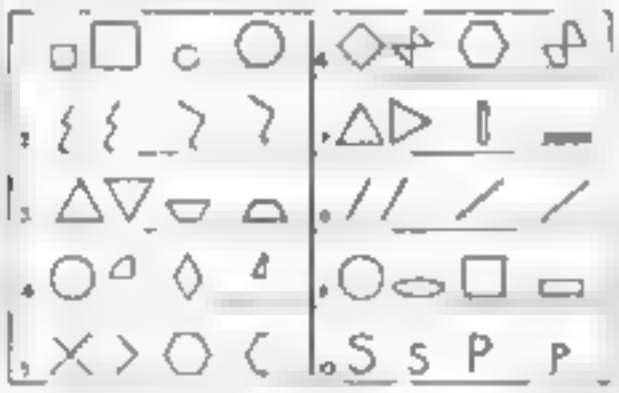
Mixed Sentence Test

Count each sentence that is marked correctly 1 point. The average person makes 10 points. The correct answers are:

1. True	6. False	11. True
2. False	7. True	12. False
3. False	8. False	13. False
4. True	9. False	14. False
5. False	10. True	15. True

Form Analysis Test

Each correct drawing counts 2 points. If you have ability in this line, you should make a score of 14 points. The correct drawings are:



Language Test

Each sentence correctly completed scores 2 points. Each one completed correctly but with words not quite as good as the key words, counts 1 point. Mark zero any other sentence that does not make good sense or in which a word is omitted.

The average score for this test is 30 points. The key words are:

1, is, 2 to 3, gave, 4, girl, with 5, is, than, 6, girls, men 7, looked, real 8, sun, in sets 9, the of a 10 can, 11, dog, had eat 12, works, will 13 are, accustomed, 14, hard, who, asks, 15, has, frequently, worse, 16, not where may 17, difficult well, with, are, 18, begun, without, is, had, 19, self, more actions, 20, sleepy often, unable, upon 21 how, to, one the, man, by, 22 injuries, done, angry, more, who 23, make, worth, effort 24, take, form, kind, has, finds, difficult.

Word Naming Test

If you have written 61 words, you have a vocabulary as good as the average individual. If you have written more than this, you are above the average. Seventy-five words or more indicate superior rating. If you have less than 50, get to work with your dictionary or spend more time reading.

Addition Test

If you are as good at addition as the average, you should complete the 100 additions in 7 minutes, 15 seconds.

Here Are Correct Answers to Questions on Page 52

1. The air is likely to be moistest close to the ground where it is in contact with damp vegetation. It is also likely to get chilled close to the ground for if there is any cool air anywhere about it sinks down next to the ground. The mixing of moist air and cold air makes the fog.

2. The sound is due to the very rapid vibration of the bee's wings.

3. No. The proper amount of food varies so widely for different people because of individual characteristics and circumstances that no general rule can be laid down. If you are uncertain whether you are eating food that is proper for you, talk it over with your doctor.

4. In the ordinary match all of the necessary chemicals are in the same mixture in the head. In safety matches some of the chemicals are put in the head but one of them is not. This one is put on the side of the box. Rubbing the match on the box brings all the necessary chemicals together and enables the match to go off.

5. Certain living cells in the petals of the flower manufacture an oily chemical which produces the odor just as cells in the olive manufacture olive oil.

6. The molecules of starch insert themselves into the tiny spaces between the fibres of the threads in the clothes and stick these fibres together, just as glue might do.

7. It is about the same size as the earth and is probably a good deal like it except that Venus is warmer, being about twenty-five million miles closer to the sun than we are. What the surface of Venus is like we do not know, for we see only a uniform, glistening white.

8. No. The stars are hot and shine by their own light while the light of the planets is mostly sunlight reflected back by them to us.

9. The eye-ball is moved around by four muscles so that we can see in different directions. Sometimes the inside muscle pulls too strongly or the outside one too weakly and then the eye is turned inward.

10. Nearly all kinds of greases and fats are soluble in benzine. The benzine simply dissolves the grease.

11. The hardest ordinary rock is granite, though some varieties of the rock called quartzite are almost as hard. Many minerals are harder than granite but are never found in large enough masses to be considered rocks. The hardest mineral is the diamond.

12. The hot air of the room dries the water out of the petals of the flowers very rapidly, more rapidly than new water can be supplied by being soaked up through the stem of the flower.

To Cure Starting Troubles

(Continued from page 86)

"The rest of the carburetor is where the gasoline is mixed with the air before it is fed into the cylinders. No two makes of carburetor look alike, but they all work on the same principle. From the float chamber there is always a small opening that leads into the air passage, and when the air rushes by it picks up the gasoline in the form of a spray just like one of these atomizers you use on your throat.

"NOW THERE is a certain amount of gasoline in proportion to the quantity of air that gives the best kind of an explosion in the cylinder and the most power. When you have too much gasoline the motor runs sluggish and usually there is black smoke coming out of the exhaust. Too little gasoline gives weak explosions, too, and sometimes the carburetor backfires because the mixture burns so slow that it is still burning in some corner of the cylinder when the inlet valve opens to let in a fresh charge and ignites the fresh charge, which blows back through the carburetor.

"Of course the speed with which the air goes by the little opening makes a lot of difference in the amount of gasoline that is picked up. Some carburetors keep the mixture uniform by using two small openings for the gasoline. One works all the time and the other only when the throttle is opened.

"Other types change the size of the opening by connecting the needle valve with levers to the throttle. Then there are types where the opening is fixed and the air passage is so shaped that even when the throttle is nearly closed and the air moving through the pipe rather slowly, it still is moving pretty fast past the gasoline jet.

"WHICH kind is this one here?" inquired the car owner.

"It's one of the two-jet type. You adjust the low-speed jet while the motor is running idle, and the high-speed jet when the throttle is open pretty well. You don't have to race the motor, though. It is usually enough to yank the throttle open for a second or two and see if the engine responds properly. If it takes hold right away without choking up or backfiring, you can be sure that the high speed jet is somewhere near right. Keep both jets turned down as far as you can and still have the motor respond right if you want the best economy.

"That's about all there is to carburetors except to remember one thing. Mark the little wheels or nuts that control the jets and, when you make an adjustment, be sure that you remember the amount of change you make so that you can put it back where it was in the beginning if you get it all out of whack.

"Those marks will help you to check the quality of the gas you are using, because, if you find that you have to open either of the needle valves more than usual when you buy a new supply of gas, it means that the new gas is not as good as the old. I'll bet that when you get some good gas in this bus you can turn both jets down

(Continued on page 138)

To Cure Starting Troubles

(Continued from page 15)

quite a bit and still have it run fine."

"Sounds kind of simple," observed the car owner. "But what made it stop here, I wonder?"

"That's easy," replied Gus. "You had some gas in the tank when you put this bum stuff in, and it took a while for the new gas to work through the vacuum tank to the carburetor. Then perhaps a piece of grit or something got in the jet just at the wrong time, the motor stopped, and you couldn't get it started again because the new gas would not start with the setting that was right for the old gas.

"By the way, don't blame the gas the first thing when the motor begins to miss or backfire. It may be a bit of dirt in the jet that is causing the trouble. Open up the jet for a second or two."

"WELL, stranger, I sure am obliged to you," said the owner gratefully, as he folded his lanky frame under the wheel and pushed out the clutch.

"Hop in, Joe," said Gus. "We ought to be back at the garage by now."

"Do you suppose he will ever get to know how to take care of a car?" asked Joe, as they drove off.

"I wouldn't bank on it," grunted Gus. "He'll probably end up by putting oats in the gasoline tank and saying 'Whoa' when he ought to put on the brake."

Can Dreams Be Controlled?

WHAT would you like to dream about tonight? A. J. Culbertey, a Cambridge University psychologist, says you can make dreams to order by pasting little squares of paper on your skin. The tension or loosening of the skin in certain areas bring about the sensations that cause dreams.

A bit of paper stuck on the lower part of the leg brought about a dream of being kicked by a horse. Diminishing the tension caused a dream of slipping or falling.

By this method, it is said, dreaming is put on a basis where it can be investigated.

War Waged on Prairie Dogs

TOURISTS through Wyoming and New Mexico are entertained by little prairie dogs that rise on their haunches as the train or automobile goes by. But the natives of those states do not find them amusing. They destroy valuable land, and for the past few years relentless warfare has been waged against them.

In one Wyoming county an area forty-eight miles long and twenty miles wide has been cleared of the destructive pests.

On the Trail of Vitamines

VITAMINES are everywhere, but no one has yet actually seen a vitamine. But scientists working persistently to isolate them are seemingly close on their heels.

Dr. Takahashi, a Japanese investigator, has isolated a product from cod liver oil which is potent when diluted one million times. Dr. Levene, of the Rockefeller Institute, New York, has obtained a product from yeast which is active when diluted one hundred thousand times.

Winners of Grand Prizes

(Continued from page 65)

runs the household for her father. In her childhood days none of her three brothers was handy with tools, when she wanted anything she made it herself. When she was a little girl, she built her own playhouse, even shingling the roof. In her home she has built an aquarium, a bird cage, and a cupboard for her fruit.

THE pleasure which the announcement of Grand Prize winners brings, however is not untouched by sadness. For the winner of the Second Grand Prize—Milton A. Graves, of Evanston, Ill. never will know of his good fortune. Only a few days after the $10,000 contest closed, he lost a life-long struggle against ill health.

Although crippled by infantile paralysis since childhood, Mr. Graves had a passion for mechanical things. He attended the University of Illinois for two and one half years, and Northwestern University half a year. Only recently he perfected an automotive invention. He never was strong enough to earn his own living, yet by working on the POPULAR SCIENCE Monthly contest during the summer, most of which time he was ill he earned a prize of $1,000, which now will go to his estate.

Youthful determination, more than anything else, was the thing that brought success to John C. Elder, of Somerville, N. J., winner of the Third Grand Prize of $500. After spending five years earning his own living, Elder determined to have a college education, and at the age of 27 entered Rutgers College, where he is now a sophomore.

"I went into the POPULAR SCIENCE MONTHLY contest for two things I could actually get out of it," he explains quite frankly. "One was to acquire practice in putting words together on paper and the other was because of the possibility of adding to the means of continuing my college work. I am more than glad to see that this latter reason was actually as practical as the first.

AND now, with the great $10,000 contest ended, POPULAR SCIENCE MONTHLY offers a fascinating new opportunity for the same sort of entertainment and profit. Don't miss the new John and Mary Newlywed Picture Contest which you will find elsewhere in this issue.

Following is the complete list of the 300 winners of grand prizes in the $10,000 contest. Photographs of some of the leading winners will be found on pages 53, 56, 57, and [illegible].

FIRST PRIZE—$2,500
Louise Gardiner Walshe, Jersey City, N. J.

SECOND PRIZE—$1,000
Estate of Milton A. Graves, Evanston, Ill.

THIRD PRIZE—$500
John C. Elder, Somerville, N. J.

FIVE PRIZES—$50 EACH
Chas. V. Fairchild, Los Angeles, Calif.
Clinton Grahill, Washington, D.C.
G. A. Graham, Baltimore, Md.
Mrs. Theresa Solomon, New York City
Mrs. H. H. Walker, New Orleans, La.

[illegible] on page 142

WARNING!

You can't become an Electrical Expert without thorough training

I have trained 20,000 men in my big schools. And I know how long it will take and to become an electrical expert.

I know what a very short time ahead in America offers the trained man. And I have proved that my way of expanding electricity is the right way.

I don't promise you a big pay electrical job as soon after you enroll for my course. But

No matter what promises any other electrical school may make, I will guarantee to give in quantity of training and time at least double what you get the big pay job you want.

I mention these points with a full intent to show I might have to say that my training is the most thorough. I intend to show you that my course is the most complete and up to date. And that you can learn quickly. Work right with me for a few months on a half million dollars worth of new electrical equipment. Learn by doing.

I Help You All Through Your Life!

When you enroll for my course you get what I call Job Service. It is a system of employment service for graduates. It is unique. It is complete. It is always active. Call it what you will, it is the most helpful service ever rendered to students by any school.

When you graduate, my National organization in the heart of California is at your service. It is the employment headquarters for the entire West.

SPECIAL!

Reduced Summer Tuition Rates NOW!

Excursion Fares to Los Angeles on all Railroads!

With National Training You Know MORE than Other Men

Don't you see that by a few months of training at my school you can be in a position to know more than men who have been in the electrical business for years? You can be ready to step into a big job. You can be ready to step into your own business. You can be ready to step into a position as foreman or superintendent. You can be ready to step into a position as electrical engineer. You can be ready to step into a position as electrical contractor. You can be ready to step into a position as electrical inspector. You can be ready to step into a position as electrical salesman. You can be ready to step into a position as electrical instructor. You can be ready to step into a position as electrical draftsman. You can be ready to step into a position as electrical estimator. You can be ready to step into a position as electrical foreman. You can be ready to step into a position as electrical superintendent. You can be ready to step into a position as electrical engineer. You can be ready to step into a position as electrical contractor. You can be ready to step into a position as electrical inspector. You can be ready to step into a position as electrical salesman. You can be ready to step into a position as electrical instructor. You can be ready to step into a position as electrical draftsman. You can be ready to step into a position as electrical estimator.

My Free Catalog Tells the Truth

Think it over. I will send you my free book of facts. It tells the truth about my school. It tells the truth about my graduates. It tells the truth about my training. It tells the truth about my employment service. It tells the truth about my tuition rates. It tells the truth about my excursion fares. It tells the truth about my reduced summer tuition rates. It tells the truth about my special! Reduced Summer Tuition Rates NOW! Excursion Fares to Los Angeles on all Railroads! It tells the truth about my With National Training You Know MORE than Other Men. It tells the truth about my My Free Catalog Tells the Truth. It tells the truth about my Write for this free catalog. It tells the truth about my FREE ELECTRICAL CATALOG. It tells the truth about my NATIONAL ELECTRICAL SCHOOL LOS ANGELES, CALIF. It tells the truth about my Dept. 633, 4004 So. Figueroa St. It tells the truth about my I want to know how to make $[illegible] in Electrical Work. Send your FREE Catalog. It tells the truth about my Name. It tells the truth about my Address. It tells the truth about my City. It tells the truth about my State. It tells the truth about my Age. It tells the truth about my Occupation. It tells the truth about my Write for this free catalog. It tells the truth about my FREE ELECTRICAL CATALOG. It tells the truth about my NATIONAL ELECTRICAL SCHOOL LOS ANGELES, CALIF. It tells the truth about my Dept. 633, 4004 So. Figueroa St. It tells the truth about my I want to know how to make $[illegible] in Electrical Work. Send your FREE Catalog. It tells the truth about my Name. It tells the truth about my Address. It tells the truth about my City. It tells the truth about my State. It tells the truth about my Age. It tells the truth about my Occupation. It tells the truth about my

Write for this free catalog. It tells the truth about my FREE ELECTRICAL CATALOG. It tells the truth about my NATIONAL ELECTRICAL SCHOOL LOS ANGELES, CALIF. It tells the truth about my Dept. 633, 4004 So. Figueroa St. It tells the truth about my I want to know how to make $[illegible] in Electrical Work. Send your FREE Catalog. It tells the truth about my Name. It tells the truth about my Address. It tells the truth about my City. It tells the truth about my State. It tells the truth about my Age. It tells the truth about my Occupation. It tells the truth about my

Dept. 633, 4004 So. Figueroa St.
I want to know how to make $[illegible] in Electrical Work. Send your FREE Catalog.
Name
Address
City State Age

Winners of Grand Prizes

(Continued from page 145)

FIFTY PRIZES—$10 EACH

Kenneth L. Barrett, Ft. Myers, Fla.
Lieutenant Commander Paul M. Bates, McCook Field, Dayton, O.
H. F. Bell, Carbondale, Pa.
F. O. T. Bickley, San Diego, Calif.
Edward C. Boshek, Helena, Mont.
Erwin T. Brown, Pittsburgh, Pa.
B. O. Burgin, Albany, N. Y.

Dr. R. S. Clinton, Washington, D. C.
George B. Cox, Madison, Wis.
Mrs. P. H. Crago, Wilkinsburg, Pa.

Ernest H. Dale, Philadelphia, Pa.

A. J. Fisher, Royal Oak, Mich.
Glen D. Fleak, Beaumont, Tex.

Joseph H. Glasser, Cleveland, O.
Commander W. D. Greetham, South Charleston, W. Va.

L. O. Hammond, Columbus, O.
Charles Haunson, St. Louis, Mo.
L. H. Hendershot, West Hartford, Conn.
Robert E. Hester, Oakland, Calif.
F. P. Hodgkinson, New York City.
Miss Rutherford D. Holdridge, Los Angeles, Calif.
Ben Howard, San Diego, Calif.
George D. Hugo, Seattle, Wash.
E. H. Hutton, Hackensack, N. J.

C. L. Isley, Jr., Memphis, Tenn.

Frances R. Jones, Coronado, Calif.

Charles Karberg, Cleveland, O.
R. W. Kennedy, Perkasie, Pa.
A. Hamilton King, Waverly, Va.

James C. Lamb, Warsaw, Va.
A. E. Livingston, Wayne, Pa.
John M. Lorens, Los Angeles, Calif.

Harrison MacGregor, Springfield, Mass.
Nina E. M. Leland, Houston, Tex.
Gordon B. Mess, Indianapolis, Ind.
Byron E. Moore, Los Angeles, Calif.

E. L. Nichols, Fairmont, W. Va.
W. C. Nicol, Pittsburgh, Pa.
Leslie Nobl, St. Louis, Mo.

Lloyd Phelps, E. Bakersfield, Calif.
Laura Pullen, Bandon, Ore.

P. W. Rushforth, Honolulu, T. H.

H. T. Shrum, Oshkosh, Wis.
Albert L. Snedeker, Mt. Ephraim, N. J.
Howard H. Sweet, Attleboro, Mass.

Lester E. Tookey, Denver, Colo.

Howard M. Van Alstyne, Rensselaer, N. Y.
Chester A. Velare, Los Angeles, Calif.

William T. Wehl, Peoria, Ill.
J. W. White, Scranton, Pa.

250 PRIZES—$5 EACH

James F. Adams, Albany, N. Y. Marion J. Adams, Pasadena, Calif. Mrs. Elsworth Adee, Denver, Neb. Frank M. Anderson, Mesa City, Mont. Julius K. Anderson, Alameda, Calif. Herbert Bade, Glen Head, Long Island, N. Y. Raymond K. Bailey, Cedar Falls, Ia. Ernest R. Baker, Confluence, Pa. George V. Baker, Pocatello, Ida. L. J. Baker, Helena, Mont. A. L. Ballschmiter, Newark, N. J. E. H. Barber, San Diego, Calif. Wm. E. Barnaby, Beverly Hills, Calif. R. M. Bear, Washington, D. C.

Fred E. Beaumont, New Bedford, Mass. Arthur P. Beckman, Belvidere, Ill. Frazer L. Belknap, New York City. Charles W. Belt, Newark, O. E. B. Benson, Rock Island, Ill. Wayburn M. Benson, Springfield, Mass. Paul E. Berg, Baltimore, Md. E. A. Bernier, Ste. Agathe des Monts, Quebec, Canada. Margaret W. Birkey, San Diego, Calif. C. W. Bisbee, Washington, D. C. Darcy B. Boone, Chicago, Ill. Mrs. Charles O. Booth, Toledo, O. Mildred S. Bottrell, Milan, Mich.

W. S. Bowman, Orangeville, Pa. Edward F. Branon, Bolton Heights, Pa. F. Canal, W. E. Branthover, Vandergrift, Pa. H. O. Brimann, Savannah, Ga. H. M. C. Burrowes, Grove City, Pa. C. A. Bussard, Spokane, Wash. C. A. Butterworth, Los Angeles, Calif. High Cameron, Winnipeg, Man., Canada. C. A. Campbell, Los Gatos, Calif. G. V. Campbell, New York City. Tim Chamberland, Montreal, Canada. R. P. Chapman, Jr., Charlotte, N. C. L. A. Chilfred, Detroit, Mich. H. A. Coleman, Bingham, Me.

Newton E. Coler, Tarpon Springs, Fla. Ila G. Cottrell, Portland, Ore. Irene J. Connelly, Los Angeles, Calif. H. A. Connie, Edmonton, Alta., Canada. Mrs. John F. Costello, Northport, Wash. Samuel Lee Craig, Principio Furnace, Md. A. Daeschner, Boulder, Col. E. T. Dana, New York, N. Y. W. B. Davis, Princeton, W. Va. W. C. Davis, Twin Falls, Idaho. Leslie de Bonnet, San Francisco, Calif. Julian A. Dietet, Naperville, Ill. George H. Deppe, Omaha, Neb. C. R. Dilbey, Syracuse, N. Y.

(Continued on page 150)

Money-Making Tools

Many BEGINNERS Make $50 a Week; Many of my Graduates Getting $90, $100 and MORE Drafting!

Drafting is the BIG field, men! Every industry you can name BEGINS with the draftsman. Without mechanical drawings—by the thousands—every shop in the land would be STOPPED. I'll teach you drafting by mail, in record time!

PAY AS YOU GO DON'T give me the excuse that you have no ready money for this golden opportunity. I am not so interested in cash, I want your application. I want at least 25 men to start right away. I want them ready to recommend by Feb. 1. We will get a flood of letters saying "send us draftsmen," from every part of industrial and engineering concern, and we must make good. In fact it is the BEST OF ADVANTAGE of depression that brings this offer. I can furnish instruments, supplies, even to the table, to those who start now!

GOOD POSITIONS POSITIONS loom up almost as soon as you are enrolled as a home student. We receive requests daily for junior men—for men only partly through our course. We'll take a beginner "some courageous with us" so long as he is a tube trained man and has begun right. The smallest town has lots of drafting jobs! The cities are clamoring for draftsmen. At home, or any spot you can name, drafting offers every opportunity. Twenty Dobe graduates went to Florida last year; three are in Japan; one wrote me from [illegible]. But a career awaits you right at home, if you'll just learn the simple, interesting principles of draftsmanship!

IT'S EASY AND interesting to learn drafting. You need no talent for drawing, it's all done by rules, and with tools. One of my students is 61 years old; another is just seventeen. But they'll all be making a good salary next season! I guarantee to make of you a finished draftsman who can grasp the opportunity and clip this coupon for my new, beautiful illustrated book!

CHIEF DRAFTSMAN DOBE
1951 Lawrence Avenue, Chicago Dept. 3-64

Send me PROOF and PORTFOLIO in time for [illegible] BEST you now look, free of obligation, Draftsmanship and Industrial on your home course, etc., etc.

Name
Age
Address
City State

The Light that Never Fails
RAY-O-LITE POCKET LIGHTER

[illegible] Per Dozen $3.00
Per Gross $30.00
Deposit with all C. O. D. orders.

RAPID MFG. CO., Dept. X,
799 Broadway, New York

Electrical Engineering In One Year

[illegible] Electrical Engineering and Mechanical Drawing. Prepares for your profession in the most interesting city in the world.

BLISS ELECTRICAL SCHOOL
[illegible] Washington, D. C.

Winners of Grand Prizes

(Continued from page [illegible])

Herbert A. Dockham, Crockett, Calif. Edward P Drake, South Bend, Ind., H. E. Dunn, Winona Minn., James Dunn, Kansas City, Mo. Philip J Eberhardt, Galena, Ill. Gustave J. Ernst, Philadelphia, Pa. William Essig, New York City. Florent D Felix, Hackensack, N J. Ira Fitzgerald, Hilltop, W Va., Edward J. Frank, Schenectady, N Y. Frank W Gaskins, Norwood, O. George F Geis, Johnstown, Pa., Thomas F Glass, Cumberland, Md.

William P Goodwin, Hemphill, W Va. Walter H Gordon, Richmond, Va., Kenneth H Goward, Lowell, Mass. Leo Grassn, Washington, D C. Joseph Greene, New York City. Lewis D Greenway, Seattle, Wash., W B Griffin, Pinar de Rio Province, Cuba, R J Griffith, Ronda, W Va. Fred H Hackett, Wakefield, Mich. G M Hardy, Easton, Wash., Roy B. Harris, Columbus, O. Walter C Harris, Brooklyn, N Y. L. S. Haskin, Glenham, N. Y. Thomas F Hayes, Marietta, O.

Raymond H Hays, Washington, D C. Hugh Hazelton, Englewood, N J. Yngve Hedner, Spokane, Wash. Vernon Hendren, Moline, Ill. Alfonso Hering, Santiago, Chile, S. A. Mrs. Mabel Hessberger, Lackawaxen, Pa. E. B. Hill, Syracuse, N Y. C M Hind, Seattle, Wash. J B Hobson, Fort Smith, Ark. Billy N Holland, Aurora, Ill. H H Holloway, Hollywood, Calif. E R Holmes, New York City. Charles A. Houston, Detroit, Mich.

Stephen Howland, St Petersburg, Fla.; W B. Hodgins, Hampton, Va. Walter F Huge, Laporte, Ind. William Humine, Cleveland, O. Sue W Hunt, Haddonfield, N J. Mrs J E. Hyneman, Ocala, Fla. Nathaniel Israel, Brooklyn, N Y. Edgar Jackson, Milpitas, Calif. Henry Jensen, Fort Dodge, Ia. Mrs. E L. Johnson, Nashville, Tenn. Edwin Lee Johnson, Nashville, Tenn. H Lewis Jones, Ft McKavett, Tex. Elmer C Jurkat, Cedarville, O. John Kauffman, Ronda, W Va.

Raymond A. Keirle, San Diego, Calif. M. J. Kelly, Elkins, W Va., Turney C. Kealy, Vineland, N J. Harry H. Kern, Cornell, Wis. Ruth H. Kiernle, Schenectady, N Y. H S. Kilbourne, Denver, Col. C A. Kittenge, Montgomery, Ala. Edward B Klein, Pleasantville, N Y. M. Klecenek, Rudolph, Wis. Reuben Koch, Dayton, O. E Kramer, Point Loma, Calif. Victor Krenvitzky, Denver, Col. Henry R Krueger, Waukesha, Wis. Ray F Kuns, Cincinnati, O.

C W Lange, Erie, Pa. L T. Landby, Chicago, Ill. Ralph J. Leonard, St. Louis, Mo. R. Y Leslie, D. D S. Pasadena, Calif. Mr. and Mrs. Gustave C Lindquist, Los Angeles, Calif. James T. Lipford, Pittsburgh, Pa., E. R. Lipe, Louisville, Ky. J G Lipe, Louisville, Ky. D. M. Love, Yazoo City, Miss. Irving C Lovejoy, Chicago, Ill. H. I Lowman, Dayton, O. Joseph P. Machover, Cedar Rapids, Ia. H C. Madsen, Centralia, Wash. Jesse W Mason, Cleveland, O.

Harold W Mattingly, Washington, D C. B. C Maurer, Pasadena, Calif. Frederic M Alpine, Point Loma, Calif. Dale McNally, Los Angeles, Calif. Charles M Meech, Glendale, Calif. Reginald B. Meier, San Francisco, Calif. Leslie A. Messenger, Astoria, N Y. Matthew H Millar, Edmonton, Alta. Canada. S Mondel, St Bernard, O. C William Ladd Moody, Newport, R. I. C E Morse, Des Moines, Ia. Archie Mumma, Dayton, O., Mrs. E. R. Munger, Helena, Mont.

S L. Nash, Chesley, Ont., Canada. Herbert H. Neale, New York City. Arthur W Neidlinger, San Anselmo, Calif., J. B. Nelson, Pittsburgh, Pa., Karl E Nelson, Newton, Kan. Charles S Nichols, Ames, Ia. L. H Nyhagen, Maplewood, N J. Charles M Oliver, Stamford, Conn. Fred J Olsen, Milwaukee, Wis. Louis G Ostness, San Francisco, Calif. C O. Parker, New York City. E. H Parker, Hartford, Conn. William B. Parmelee, Chicago, Ill., C E. Paroni, Colorado Springs, Col.

H A Partridge, Shelton, Conn. William J Patrick, Brooklyn, N. Y. Edward Patterson, Oklahoma City, Okla., R. A. Payne, Springfield, Mass. Mrs. E A Perkins, Houston, Tex. Oscar R Peterson, Youngstown, O. Albert P Pioreca, Cleveland, O. M E Preston, Spokane, Wash. R F Purdy, Raton, N M. Rodney E. Reed, Bellevue, Idaho, Thomas Reedy, Denver, Col. A A Reimer, New York City. Mrs. Agnes E Reimer, East Orange, N. J., Harry Reynolds, Oakland, Calif.

Lieutenant Lester F Rhodes, Hawaii; Luke H. Richard, Bradford, Mass., James A Richardson, Duluth, Minn. O B. Riggs, Newport, Ind. A L. Robinson, Stockton, Calif., Mrs C C Rodarty, Los Angeles, Calif. H M Rose, Huntingdon, Pa. C. S. Rogers, Spokane, Wash. Hugh J Ross, Regina, Sask. Canada; A. H. Rowe, Port Arthur, Tex. H H Rudd, Roanoke, Va., Harry F Sampson, Brockton, Mass. H. L. Schick, Elverson, Pa.

(Continued on page [illegible])

Winners of Grand Prizes

(Continued from page 141)

Arthur A. Schneider, Cleveland, O. G. Schumacher, Brooklyn, N. Y. R. Schwarzberg, New York City. Jennie B. Scott, Houston, Tex. Walter T. Scott, Pittsburgh, Pa. M. Sekeeman, Los Angeles, Calif. John B. Shaw, Los Angeles, Calif. Thomas S. Shott, Amagansett, New York. Raymond Shotwell, South Tacoma, Wash. William Simonson, Mineola, N. Y. Robert H. Simpson, Minneapolis, Minn. Fred Skerrett, East Moose Jaw, Sask., Canada. A. A. Smith, Sharon, Pa. B. L. Smith, Brockton, Mass.

E. P. Smith, Chattanooga, Tenn. Lopez B. Smith, Richwood, W. Va. Margaret E. Smith, Oxford, N. Y. Pearl Smith, St. Paul, Minn. A. J. Snow, Salt Lake City, Utah. A. E. Snyder, Queens Village, N. Y. Edward M. Starkey, Berlin, Wis. Wayne E. Stevens, Parco, Wy. Paul Sutherland, Iosp[illegible], Ariz. Edna L. Swanson, Kenilworth, Ill. Harvey B. Tailey, Washington, D. C. Richard C. Tarr, Gloucester, Mass. A. A. Tibbits, Portland, Ore., Charles B. Timmons, Middleton, O.

A. W. Townsley, Columbus, Mont. Eva B. Townsley, Columbus, Mont. Ernest R. Toye, St. Helens, Ore. A. F. Trumbull, Portland, Ore. L. Raymond Twyman, Fayette, Mo. E. J. Uhl, Dayton, O. H. Davis, Portsmouth, Va. W. T. von Tillow, San Francisco, Calif. R. A. C. Walker, Lynchburg, Va., August H. Warnecke, Berkeley, Calif. John H. Warner, Dayton, O. Henry Warrington, Sutter Creek, Calif. Angeline Wes, Winona, Minn. Eugene A. H. Watson, New York City.

George A. Webster, Glens Falls, N. Y. A. L. Wedemeyer, Columbus, O. Dr. Charles J. Wehr, Bellevue, O. L. E. Welch, Elizabeth, N. J. David C. West, Lake George, N. Y. John A. Whamer, Schenectady, N. Y. R. S. Wheeler, Elverson, Pa. Orval Whisman, Rockford, Ill. Gordon C. Willard, Washington, D. C. Harry C. Williams, Monterey Park, Calif. H. S. Williams, Vegreville, Alta., Canada. E. Widner, East Elmhurst, N. Y. Jacob E. Wilson, Yoncalla, Ore. Harold G. Woodburn, Munhall, Pa.

M. E. Wooden, Memphis, Tenn. Stephen A. Yesko, Washington, D. C. George J. Zehrung, White Plains, N. Y.

The Magic of Chimes Grips America

(Continued from page 33)

compared with the making of a great violin or the designing of a clear-toned loud speaker.

So it is that the bell designer's laboratory is the drafting room. Here intricate curves for patterns are plotted with mathematical precision based on a study of the science of sound and its vibrations.

The results of his labors are in the form of metal-faced wooden "sweeps," two for each bell of a given size. The dimensions of the sweeps determine the size and the key of the bell to be cast. An edge of one of the sweeps is curved to the exact form of the inside of the bell-to-be. The edge of the other is curved to the form of the outside.

RETURNING now to the workmen whom we saw earlier making molds of sand and clay, we find that these molds are built around bell-shaped iron flasks or cases. On one hand are the cores which will determine the inside surfaces of the castings, on the other, the molds that will determine the outside surfaces. On top of the sand and clay, the workmen add a coating layer of smooth black lead. And now on each mold they carefully center one of the sweeps which, revolving on a pivot, models the mold to the exact curves intended for the bell's surface.

This completed, the core mold for each bell is inserted and centered within its respective outside mold, leaving an air space into which the molten metal, drawn from the furnace, is poured to form the bell.

(Continued on page 143)

The Magic of Chimes Grips America

(Continued from page 142)

To me, the most amazing thing about this process was the fact that virtually every bell that is cast is found, when tested, to be pitched precisely to the key intended by the designer of the sweep patterns. Briefly, these patterns are worked out on the basis of bell diameters. The diameters of bells correspond to the lengths of musical strings. Suppose, for example, you play the A string of a violin. Then, if you press your finger on the string halfway down the finger-board, you will get a tone exactly an octave higher. A similar thing is true of bells. If one bell gives a certain tone, a similar bell, of half the diameter will give a tone exactly an octave higher. On that basis, it is possible to determine dimensions for bells to produce any one of the tones in the musical scale.

THE skilled bell maker, I learned, applies this same principle ingeniously in tuning bells once they have been cast. Suppose, for instance, a bell cast for the key of C is found, when struck, to be a shade too high in tone. The bell maker simply shaves off a bit of metal around the "sound bow" where the clapper strikes, thus slightly increasing the diameter of the bell and lowering its tone. Or, if the bell is a trifle too low in tone, he shaves its rim, shortening the diameter and raising the pitch.

From the foundry I made my way through the blacksmith shop where the gun metal clappers and mountings for the bells were being made, through a finishing room where motor-driven buffers and polishers were shining the bronze bells to a golden glow, and out into a wide courtyard. Here in the testing grounds hung two chimes of ten bells each, whose clappers were controlled by manuals through an arrangement of chains and pulleys.

The maker of the bells stepped briskly up to the nearest manual—a series of wooden bars that looked for all the world like a row of pump handles. Each was marked with a note of the scale. He pushed down on the handles sharply, and at once a lively tune rang through the courtyard and floated up over the housetops of Troy.

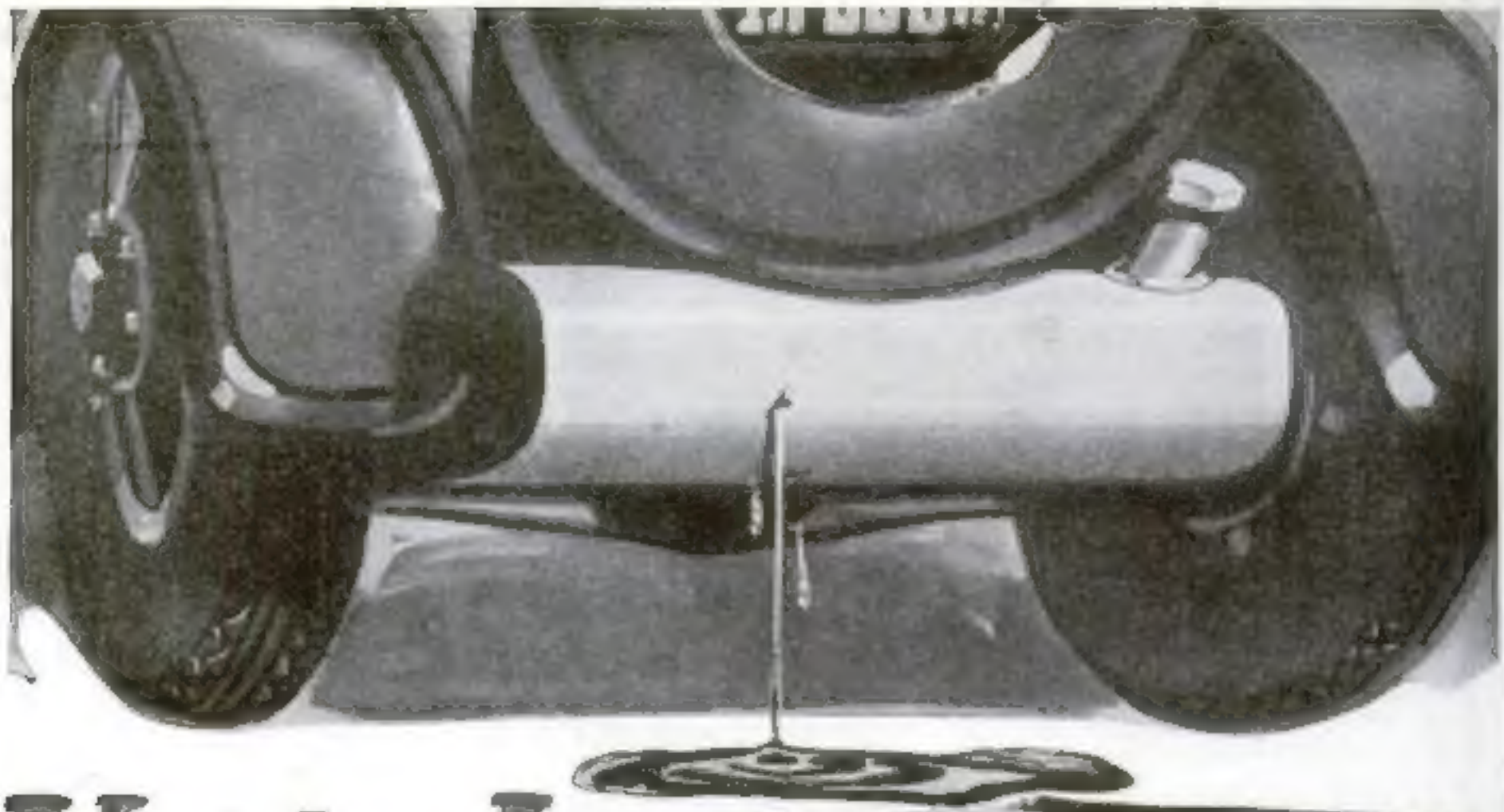
"IT'S simple," he said, when he had rung out the last measure. "Almost anyone with an ear for music can ring the bells. Just a little while ago, when I installed a set of bells at Wells College in Aurora, the first thing the girls did was to play all their college tunes. They had a great time. Here, try it yourself."

I pulled down one of the handles, and a ton and a half of metal in the biggest of the bells boomed a deep note that faded into a long-drawn melodious hum.

And with that we marched back to the office.

"But, Mr. Meneely," I said finally, "you haven't explained yet just how you plot the curves that give greatness to the voice of a bell."

"Ah," he smiled, "that's the secret!"



You're Losing Half Your Gasoline!

For every ten gallons you buy you lose five! That's a startling statement, but true. You are getting just half the power, half the mileage you should out of your gasoline! For now an amazing new invention—a ridiculously simple little device—makes any car give twice its regular mileage to the gallon! You can sell from five to twenty in one demonstration. Splendid for spare time work, many

Earn $34 to $69 a Day

You may have heard of propositions paying men big incomes, but I'll wager you never heard of anything like this. In just one hour, Mr. J. W. Cronk made $51 with the Stransky Vaporizer. It would have to make good to sell like that—it would have to be a superior article to win such quick response from the buying public, wouldn't it? Here is what he says: "The results of one hour's work—17 men save me orders for the Vaporizers.—J. W. Cronk."

Agent Earns $120 a Day

I have found out that the Stransky will do what you said it would. I took forty orders in one day, and wasn't out long. My Ford runs better than it ever did. I can save half the gas and it pulls better.—J. M. James.

$147.50 in One Day

My profits for one day were $147.50. In one week I made $281. Yes, I am always on the job.—S. E. Herrick, Ore.

$42 in 1 Hours

My gas bill has been cut nearly in half. I have removed every particle of carbon from my engine. Since I installed it, my engine runs as good as new, starts easier and quicker. I went out Saturday about three hours and secured 16 orders.—J. A. Williams.

Sells $80 in One Day

My best day's sales were $80 vaporizers the next was $60; at another time I sold 22 in 55 minutes, and at another time 27 in 45 minutes.—W. B. Eberlin.

$39 in Three Hours

In three hours on Saturday I cleared $38. In one hour on the previous Saturday I cleared $16.—T. M. Wiley, N. C.

With this wonderful new invention auto owners in all parts of the country have chalked up records of from 37 to 52 miles and even up to 91 miles on a gallon of gasoline. Every day we hear of some new record—some difficult feat such as pulling a car through deep sand, or up a mountain, on half the usual gas.

And now this amazing new invention is making fortunes for agents and distributors. Now you, too, can make big money—just selling your friends about it. J. M. James made $120 in one day! Vernon Gaines netted $94 in eight hours. J. W. Cronk made $51 in just one hour! You can easily earn astonishing big profits in full or spare time—many are earning $34 to $69 a day.

Fits Any Make or Model Car

Here's how this wonderful little device works—how it adds more power and mileage to any make or model car. Every carburetor is adjusted to make starting easy. But once the engine gets heated up the mixture is far too rich, resulting in faulty explosion. Half the gasoline is drawn into the cylinders in a raw state, and, instead of exploding, it burns. This causes a heavy deposit of carbon.

But with this startling little device in a car all this is changed. As soon as the engine warms up, this device automatically begins to admit a much larger volume of air, thoroughly vaporizing all the gasoline, giving it fully 50% more power—breaking it up so that it explodes instead of burning.

A Carbon Remover

Not only does this invention save half the gasoline, but it also saves the expense and time of having carbon scraped out—a job costing from $5 to $25.

Introductory Sample Offer

To introduce this new invention, Mr. Stransky, the inventor, will send a sample at his own risk. Not only that, but he will actually pay you for testing his Vaporizer if you are not delighted with it! Write at once for his proposition, and learn how you too, can

Make $250 to $500 a Month

The demand for the Stransky Vaporizer is enormous. Agents handling this device are simply coining money. Every auto owner in the country—and there are twenty million of them—wants this splendid new invention the minute he sees it. You can sell from five to twenty in one demonstration. Splendid for spare time work. Many former agents are devoting all resources increase as distributors and crew managers. Farmers with no experience are scoring in orders in 100 lots, netting them two to three hundred dollars. This may sound like big money. It is big money—it is a big proposition—the biggest every brought to your attention.

Just send the coupon at once for full details of our introductory sample offer. Be the man to cash in big in your community. Mail the coupon right now—today!

J. A. STRANSKY
MANUFACTURING COMPANY
D-730 Stransky Bldg., Pukwana, So. Dakota

Mail This Coupon Today

J. A. Stransky Mfg. Co.
D-730 Stransky Bldg., Pukwana, South Dakota

Tell me how I can get samples of the Stransky Vaporizer at your risk. Also tell me how I can make from $34 to $69 a day as your distributor. This does not obligate me in any way.

Name.....

Street or R. F. D.....

City..... State.....

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

"I love the fragrance of good pipe tobacco"

Julia Hoyt

Quality created the demand— Demand made possible the price

NOW 12¢

© Guaranteed by The American Tobacco Co.

Exactly why *you lather your face before shaving*

SOAP does not soften the beard. It is *water* that softens the beard.

But water alone won't even wet one whisker. A growing whisker has an oily surface and turns water like a duck's back. You have got to get rid of that oil before water can get at the whisker.

How water gets into the whisker

Colgate's Rapid-Shave Cream gets water into the beard this way: Certain ingredients in the Colgate lather remove that oil (emulsify it, the chemists say), and then the lather holds the water that it has absorbed, close against the base of the beard.

How the Colgate lather softens the beard at the base

There is just one part of the whisker that needs to be softened. That is not the end of the whisker, nor the middle of the whisker, but the *base of the beard* where the razor edge meets it.

The great advantage of Colgate's Rapid-Shave Cream is that the Colgate lather consists of myriads of tiny bubbles that contain proportionately much more water and much less air than large bubbles . . . the more bubbles the less air, and the more water; and remember that water is the *real* softening agent.

These tiny bubbles with their shell of water can nestle right at the base of the beard, and the softening process takes place at exactly the point where it is important that the beard should be soft.

A pleasant-feeling face

The nice chemical balance secured in Colgate's Rapid-Shave Cream produces a lather that does its work in either cold, warm, or hot water, and softens the beard without withdrawing the oils of the skin. The result is that your face is never irritated—no dry or burning sensation, but feels cool and smooth after shaving.

Colgate & Co.
Est. 1806
NEW YORK

Return this coupon with 4c, and we will mail you a trial tube of Colgate's Rapid-Shave Cream.

COLGATE & CO.
Dept. 143-D, 581 Fifth Ave., New York

Please send me the trial tube of Colgate's Rapid-Shave Cream for better shaving. I enclose 4c.

Name .....

Address .....

.....

In Canada, Colgate & Co., Ltd. 72 St. Ambroise St., Montreal

Colgate's softens the beard at the base